COMPLEXUL MUZEAL BISTRITA - NĂSĂUD

STUDII ȘI CERCETĂRI

Geologie - Geografie

10

BISTRIȚA

2005

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Editorial office: 19 General Grigore Bălan str., 420016

Phone 0263-211063; Fax: 0263-230046

Editura SUPERGRAPH

ISSN 1582-5167

CUPRINS. CONTENT. SOMMMAIRE. INHALT

GEOLOGY

PALEONTOLOGY, BIOSTRATIGRAPHY

Studii şi cercetări, Geologie-Geografie 10, 2005, Bistriţa, p. 13-32

THE EXTINCT *COELODONTA ANTIQUITATIS* *(PERISSODACTYLA, MAMMALIA)* FROM ROMANIA: REPERTORY OF SITES

Vlad CODREA*

Abstract. Wooly rhino *(Coelodonta antiquitatis)* is a common large mammal in the Middle and Late Pleistocene of Romania, marking the cold stadials. The repertory of sites includes a large number of localities. Some of them yielded large mammal assemblages including numerous species, while others concern the wooly rhino only. The paper comprehends data on the stratigraphy and geographic distribution of this species in our country.
Key words: Perissodactyla, wooly rhino, Middle and Late Pleistocene, Romania.

Introduction

At a first glance, one can believe that the extinct Pleistocene wooly rhino [*Coelodonta antiquitatis* (BLUMENBACH 1799), = *Rhinoceros lenensis* PALLAS 1773 = *Rhinoceros tichorhinus* FISCHER 1811] from our country falls among the best known Ice Age large mammals. However, careful review of data concerning this rhino leads to a different conclusion: in spite of the large number of Middle and Upper Pleistocene sites where it is reported, only few fossils are adequate for an intimate study. The majority of fossils refer to scattered teeth and bones. No whole (or at least, partial) skeleton is known from Romania. In spite this scarcity of well preserved fossils, some discoveries are extremely interesting and would worth an advanced study, as the ones originating from older sediments than the last glacial (*i.e.* Mindel or Riss), originating from Ţării Bârsei Depression. As Guérin (1980) already mentioned, it is possible that at least two (or more) subspecies existed in Pleistocene. This assertion seems to be supported by the discoveries of these wooly rhinos older than Late Pleistocene, but for instance the fossils are too scarce and less diagnostic to allow a clear image on the physiognomies of these old representatives.

Along 19th and 20th centuries, several geologists or archaeologists redacted repertories of sites. However, none of them gave enough data on each site. In these circumstances, as the number of discoveries is already large, I decided to compose this new repertory. It could be a useful tool not for paleontologists only but for archaeologists too, as well as for all students interested in stratigraphy and paleobiogeography.

This repertory follows the Guérin (1980) pattern, trying to form into a database for this species. Where data have been available, for each locality there are specified: the actual or older locality names, references, details concerning the find, collections where the fossil are curate, stratigraphy, mammal assemblage, special comments. The Pleistocene localities are listed in alphabetical order.

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This work involved not only a wide documentation, but also the examination of a large number of collections from different museums, institutes, universities or private, as well as several field observations. I express my gratitude to all my colleagues supporting me in such a demarche: however, I will not enumerate them, as their number is considerably too large and this paper extension, already too wide.

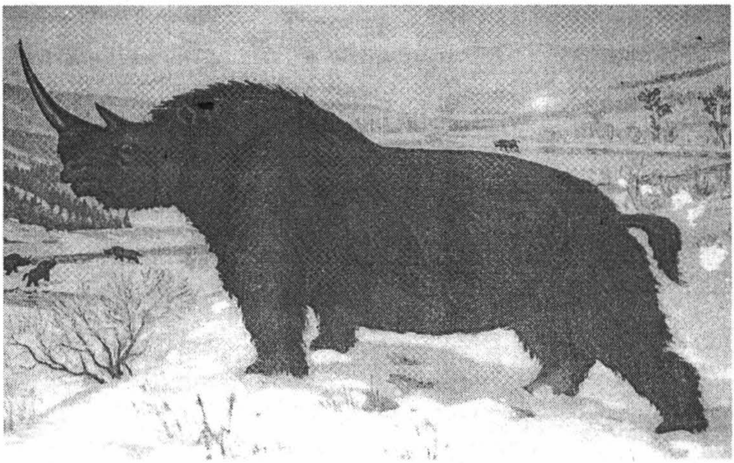

Fig. 1.
The Pleistocene wooly rhino *(Coelodonta antiquitatis).* Probably the horn was longer in male specimens. Canvas in P.S.U.B.B.M. collection by V. Constantinescu.

Abreviations:

Ai.M. – Aiud Natural Sciences Museum, Alba district.
A.I.B. – Archaeology Institute Bucharest.
B.M.T.- Banatului Museum Timişoara, Timiş district.
Bk.M. – Brukental Museum, Natural Sciences branch Sibiu, Sibiu district.
D.R.H.C.M.D.- Dacian Roman History Civilisation Deva, Hunedoara district.
E.R.S.I.B. – „Emil Racovitza" Speleological Institute Bucharest.
Gr.A.M. – „Grigore Antipa" Natural History Museum, Bucharest.
H.M.B. – History Museum Bucharest
H.M.I. – History Museum Iasi.
I.U.N.H.M. – Iaşi „Al. I. Cuza" University Natural Histrory Museum, Iaşi district.
M.A.F.I. – Hungarian Geological Institute Budapest, Hungary.
M.M. – Mediaş town Museum, Sibiu district.
N.H.M.B. – Natural History Museum Budapest, Hungary.
O.C.M. – Olteniei Museum, Natural Sciences branch, Craiova, Dolj district.
P.F.R.M. – Porţilor de Fier Region Museum, Turnu Severin, Mehedinţi district.
P.S.U.B. – Paleontology-Stratigraphy Collection, University of Bucharest.

P.S.U.B.B.M. – Paleontology-Stratigraphy Museum, University „Babeş-Bolyai" Cluj-Napoca.
P.S.U.I. – Paleontology-Stratigraphy Museum, University „Al.I. Cuza" Iaşi
Sf.Gh.M. – Sfântu Gheorghe Museum, Covasna district.
S.M. – Sebeş town Museum, Alba district.
T.C.M. – Ţării Crişurilor Museum Oradea, Bihor district.
T.M. – Târnăveni town Museum, Mureş District.
Tc.M. – Tecuci Museum, Galaţi district.
Ti.M. – Tinca Museum, Bihor district.
Tg.M.M. – Târgu Mureş Museum, Natural Sciences branch, Mureş district.

Repertory of localities

1. **Adămuş** (Mureş district); Fuchs & Konya (1967), Codrea & Botoş (1995); from the local sand open pit located on the fourth Mureş River terrace, collected by C.J. Benyi; T.M.; Riss?.

2. **Agnita** (= Szentagota; = Agnetheln, Sibiu district); Beudant (1822), Koch (1876, 1891), Goos (1876), Phleps (1926), Barbu (1930), Török (1933), Moga (1938), Nicolaescu-Plopşor (1938), Eufrosin (1942), Vörös (1983), Păunescu (2001); from Hârtibaciului Valley, without other details; Bk.M.; probably Würm.

3. **Aldea** (Mărtiniş township, Harghita district); Moga (1938).

4. **Apoşul** (= Szaszapátfalva; = Abtsdorf, Birghiş township, Sibiu district); Koch (1876, 1891, 1900), Goos (1876), Téglás (1886), Phleps (1926), Roska (1942), Samson & Hermann (1968), Samson (1975), Vörös (1983), Păunescu (2001); from löess deposits, without details; Bk.M.; Würm; *Mammuthus primigenius, Equus transylvanicus, Megaloceros giganteus, Bison priscus.*

5. **Araci-Cariera** (Covasna district); Rădulesco et al. (1965), Alimen et al. (1968), Rădulescu & Kovacs (1968), Samson et al. (1969, 1973), Macarovici (1972), Samson (1975), Kovacs (1981), Rădulescu & Samson (1985), Păunescu (2001); from the lower sequence of löess; Sf.Gh.M. and E.R.S.I.B.; Mindel; *Equus* cf. *mosbachensis, Megaloceros (Dolichodoryceros) savini, Bison* cf. *priscus.*

6. **Araci – Fântâna Fagului** (Covasna district); Rădulescu & Samson (1971, 1985), Păunescu (2001); from löess; Sf.Gh.M.;?Mindel; *Equus* cf. *missi, Bison* cf. *priscus.*

7. **Araci – Ariuşd** (Covasna district); Samson (1975), Kovacs (1981); from Ariuşd creeks; Sf.Gh.M.; Würm.

8. **Aroneanu** (Iaşi district); Butnaru (1964), Macarovici & Costeski (1973), Chirică & Tanasachi (1984); from„Cârâc sand", limonitous sand and gravel, north from the village, from V. Cârâcului exposure, 9 m depth; Würm; *Mammuthus primigenius, Megaloceros.*

9. **Avram Iancu** (Bihor district); Codrea & Gherdan (1990); from a hydrogeologic borehole (F1A), at 26 m depth; Würm; P.S.U.B.B.M.; *Equus* sp.; the horse metapodial fragment seems to be a Mousterian *grattoir.*

10. **Baciu** (Cluj district); unpublished material in P.S.U.B.B.M. collections.

11. **Baia de Fier** (Gorj district); Bombiţă (1954), Nicolaescu-Plopşor et al. (1957 a), Terzea (1965), Cârciumaru (1980), Păunescu (2000); from Muierii Cave alluvial filling; A.I.B, O.C.M., E.R.S.I.B., Würm, Mousterian; *Ursus spelaeus, Panthera spelaea, Mammuthus primigenius, Gulo gulo, Pitymys subterraneus, Cervus elaphus.*

12. **Banpotoc** (Hunedoara district); from travertine; D.R.H.C.M.D.; Würm.

13. **Beneşti** (= Bägendorf, Alfana township, Sibiu district); Phleps (1926).

14. **Bodoc** (Covasna district); Radulesco et al. (1965), Alimen et al. (1968), Samson & Kovacs (1970), Macarovici (1972), Kovacs (1981), Rădulescu & Samson (1985), Păunescu (2001); from löess sequence; Sf.Gh.M.; Riss III; *Equus steinheimensis, Equus* sp.

15. **Brătei** (locality now included to Mediaş town, Sibiu district); Rădulescu & Hermann (1969, 1971), Samson (1975), Păunescu (2001); from 12-15 m Târnava Mare valley terrace, found in „La Rogoaze" and „Rădaie" sand open pits; M.M.; Würm; *Bison priscus, Alces alces, Equus germanicus.*

16. **Bruiu** (= Braller, Sibiu district); Téglás (1915), Phleps (1926), Vörös (1983); Bk.M.; Würm.

17. **Bucureşti;** Athanasiu (1911), Barbu (1930), Nicolaescu-Plopşor (1938), Eufrosin (1942), Liteanu (1952, 1953), Bombiţă (1954), Bărat (1960), Liteanu & Ghenea (1966), Apostol (1967), Păunescu (2000); from „Colentina gravels", from different sand and gravel open pits (some consider these deposits as Argeş Valley terraces); P.S.U.B., Gr.A.M.; Würm; *Mammuthus primigenius, Cervus elaphus, Crocuta spelaea, Canis lupus.*

18. **Budureasa** (Bihor district); Jungbert (1978), Păunescu (2001); from Onceasa – Zmeilor Cave alluvia; Würm; *Ursus spelaeus, Felis spelaea, Canis* sp., *Crocuta spelaea, Cervus* sp.

19. **Bulz** (Bihor district); Toula (1882), Matyasovsky (1884), Koch (1900), Codrea & Gherdan (1990); at Iadei (Iadului) and Crişul Repede valleys confluence, unearthed at the railroad edification;,,Technische Hochschule" Viena collection; Würm.

20. **Caşin** (Bacău district); Kovacs (1981); from Szteye Creek; Sf.Gh.M.; Würm.

21. **Cernavodă** (Constanţa district); Ionesi (1994); from löess; probably Würm.

22. **Cheia** (com. Mihai Viteazu, Cluj district); unpublished material in P.S.U.B.B.M.

23. **Cheia** (Constanţa district); Nicolaescu-Plopşor (1959 a, b). Cârciumaru (1980); from Cheia and La Izvor caves alluvia; Würm, Mousterian; *Ursus spelaeus, Canis lupus, Vulpes vulpes, Crocuta spelaea, Felis spelaea, Rangifer tarandus, Bison* sp., *Sus scrofa, Capra ibex, Equus „cabalus fossilis".*

24. **Chişcani** (Brăila district); Apostol (1970, 1976), Păunescu (2000); from„Brăila terrace" in sandy löess; Gr.A.M.; Würm I; *Mammuthus primigenius.*

25. **Chişcău** (Bihor district); Codrea & Lázár (1994); from karst clastic filling in Petit Tibi pot-hole; P.S.U.B.B.M.; Würm.

26. **Cluj-Napoca** (= Kolozsvár; = Klausenburg, Cluj district); Koch (1876, 1883, 1884, 1891, 1900), Téglás (1886), Orosz (1903), Szentpéteri (1914), Moga (1938), Roska (1942), Eufrosin (1942), Jungbert (1978), Vörös (1983), Păunescu (2001); from the open pits once exploiting sand and gravel in Someş River lower terrace, at Dealul Gol, Mănăştur

area, Someşeni; part of fossils lost, another in P.S.U.B.B.M.; Würm; *Mammuthus primigenius, Equus, Marmota bobac, Spalax, Cricetus, Arvicola.*

27. **Coleşti** (Vaşcău, Bihor district); Jurcsák (1974), Codrea & Gherdan (1990), Păunescu (2001); in Răşeţ Cave, on stalagmite floor; P.S.U.B.B.M.; Würm.

28. **Cornăţel** (Sibiu district); unpublished skull, found by Traian Mihu in 1983; Bk.M.; Würm.

29. **Corneşti** (= Sinfalva; = Şonfălău, Adămuş township, Mureş district); Roska (1942), Păunescu (2001); ? Würm; *Equus* sp.

30. Coveş (= Ágotakövesd, Agnita town, Sibiu district); Staub (1894), Koch (1900), Vörös (1983); Würm; *Mammuthus primigenius, Cervus elaphus, Bos primigenius.*

31. **Crăieşti** (Adămuş township, Mureş district); Fuchs & Konya (1967), Codrea & Botoş (1995); form open pit; T.M; Würm.

32. **Cristeşti** (Mureş district); Fuchs & Konya (1967), Codrea & Botoş (1995); Mureş Valley terrace open pit; Tg.M.M.; Würm.

33. **Cuci** (Mureş district); Fuchs & Konya (1967), Codrea & Botoş (195); Mureş River lower terrace; Würm.

34. **Curtea de Argeş** (Argeş district); Mihăilă (1971), Liteanu et al. (1962), Păunescu (2000); Argeş Valley 30-40 m terrace; Curtea de Argeş

35. **Domăneşti** (= Domahida, Satu Mare district); Halavats (1897, 1898), Koch (1900), Barbu (1930), Moga (1938), Eufrosin (1942), Nicolaescu-Plopşor (1938), Csáak (1978); from Crasna Valley; M.A.F.I.; Würm; *Mammuthus primigenius, Crocuta spelaea, Bison prisons, Equus* sp., *Castor fiber,* birds.

36. **Drobeta-Turnu Severin** (Mehedinţi district); Hantken (1866), Eufrosin (1942), Ghenea et al. (1963), Apostol (1976), Păunescu (2000); an old find; some new material exist in P.F.R.M.; probably Würm.

37. **Făurei** (Călăraşi district); Apostol et al. (1979), Păunescu (2000); from Mostiştea Valley, in fine sand; Gr.A.M., ?Mindel/Riss; *Bison priscus, Equus* sp.

38. **Fântânele** (Matei, Bistriţa-Năsăud district); Păunescu (2001); form Păşune or Sub Dos, near Pleşului Valley, from löess; Fântânele school museum; Würm; *Mammuthus primigenius, Sus scrofa.*

39. **Galoşpetreu** (Tarcea township, Bihor district); Giurgea (1972), Jurcsák (1974), Jungbert (1979), Codrea & Gherdan (1990), Păunescu (2001); near Judecăţii or Legii Hill (= Torvenydomb), from Ierului Valley 10-15 m; T.C.M.; Würm; *Mammuthus primigenius, Megaloceros giganteus, Equus* sp.

40. **Galaţi** (Galaţi district); Sficlea (1960), Liteanu & Ghenea (1966), Apostol (1970), Macarovici & Costeski (1973); from löess, at Ţiglina (on the eastern side of Ţiglina Hill) and Bărboşi (near the railroad station); Gr.A.M.?; Würm.

41. **Gălăţeni** (= Szentgerice; = Sânghiriţa, Mureş, district); Koch (1891, 1900), Barbu (1930), Nicolaescu-Plopşor (1938), Eufrosin (1942), Roska (1942), Jungbert (1979), Vörös (1983), Codrea & Botoş (1995), Păunescu (2001); at „La Darac” from lehm; Ai.M., N.H.M.B.; Würm; *Bos* sp., *Equus* sp., *Mammuthus primigenius, Cervus elaphus.*

42. **Gherdeal** (Bruiu – Sibiu district); unpublished fossils collected by Gh. Duțu, Moise Coste and Michael Schoster in 1974, from Quaternary alluvia; Bk.M.; Würm.

43. **Ghidfalău** (Covasna district); Roska (1942), Liteanu (1961), Bandrabur (1967), Samson & Kovacs (1967), Alimen et al. (1968), Samson et al. (1969, 1973), Rădulescu & Kovacs (1970), Samson & Kovacs (1970), Macarovici (1972), Samson (1975), Kovacs (1981), Rădulescu & Samson (1985), Păunescu (2001); in Vajna open pit and at „Cărămidărie", towards the top of andesitic sand succession, as well as from „Cariera de pietriș"; Sf.Gh.M.; Mindel and Riss; *Equus insulidens, Mammuthus primigenius, Equus transilvanicus, Megaloceros giganteus, Felis spelaea, Marmota bobac.*

44. **Ghijasa de** Sus (= Felsögezés; = Obergesass, Alțâna township, Sibiu district); Phleps (1926); from löess, Munteanului Hill; Bk.M.; Würm; *Bison priscus.*

45. **Ghioroc** (Arad district); Păunescu 2001; unspecified site; from clastic rocks (gravels and sands); ? Würm.

46. **Hamba** (= Kakasfalva; = Hahnbach, Șura Mare township, Sibiu district); Ackner (1850), Koch (1876, 1891, 1900), Goos (1876), Téglás (1886), Barbu (1930), Moga (1938), Nicolaescu-Plopșor (1938), Roska (1942), Vörös (1983), Păunescu (2001); Bk.M.; Würm; *Mammuthus primigenius.*

47. **Hărănglad** (= Haranglab, Bagaciu township, Mureș, district); Koch (1888, 1891, 1900), Barbu (1930), Nicolaescu-Plopșor (1938), Eufrosin (1942), Roska (1942), Codrea & Botoș (1995), Păunescu (2001); Würm; *Mammuthus primigenius.*

48. **Holboca** (Iași district); Macarovici & Zaharia (1963); in SW village clay open pits, at „Izvorul Pândarului"; I.U.N.H.M., P.S.U.I.; Early Würm; *Mammuthus primigenius.* The mammoth was once assigned to *P. trogontherii.* Probably, this site belongs to mousterian „kitchen midden".

49. **Hosman** (= Holcmány; = Holzmengen, Nocrich township, Sibiu district); Koch (1876, 1891, 1900), Goos (1876), Téglás (1886), Phleps (1926), Barbu (1930), Moga (1938), Nicolaescu-Plopșor (1938), Roska (1942), Hie (1958), Samson (1975), Vörös (1983), Păunescu (2001); from 8-10 m Hârtibaciului Valley terrace; Bk.M., P.S.U.B.B.M.; Würm; *Mammuthus primigenius, Equus spelaeus, Eq. transilvanicus, Cervus elaphus, Megaloceros giganteus, Alces alces, Bison priscus.*

50. **Hulubăț** (Vaslui district); David (1922), Macarovici (1938 a), Eufrosin (1942), Macarovici & Jeanrenaud (1958), Macarovici & Turculeț (1972), Macarovici & Costeski (1973), Simionescu (1990); Vasluieț Creek lower terrace; P.S.U.I.; Würm; *Mammuthus primigenius, Bison priscus, Bos primigenius, Megaloceros giganteus* and fresh water snails.

51. **Husnicioara** (Mehedinti district); Codrea & Diaconu (2003); from Husnicioara coal open pit; P.F.R.M.; probably Würm; *Mammuthus primigenius.*

52. **Iași** (Iași district); Simionescu (1990); Bahlui River middle terrace; I.U.N.H.M.; Würm; *Mammuthus primigenius, Megaloceros giganteus, Bos primigenius, Bison priscus.*

53. **Iacobeni** (= Jakabfalva; = Jakobsdorf, Sibiu district); Phleps (1926); Bk.M.; Würm.

54. **Ilimbav** (= Illenbák; = Eulenbach, Marpod township, Sibiu district); Phleps (1926), Ilie (1958); löess; Bk.M.; Würm.

55. **Jimbolia** (Timis district); Gross (1989), Simionescu et al. (1989); Codrea et al.(1996); from „Groapa veche", the old clay open pit belonging to the former Jimbolia brick factory; P.S.U.B.B.M.; Würm; *Mammuthus primigenius, Megaloceros.*

56. **Lăscud** (Mureş district); Codrea & Botoş (1995); unpublished fossils from Tg.M.M.; Würm.

57. **Liviu Rebreanu** (neighbourhood of Năsăud town, Bistriţa-Năsăud district); from clay, 2 m depth, near the school; P.S.U.B.B.M.; Würm.

58. **Malul Mare** (Dolj district); Liteanu & Bandrabur (1957), Bandrabur et al. (1963), Schoverth et al. (1963), Bandrabur (1971), Apostol (1976), Păunescu (2000); Jiu Valley upper terrace; O.C.M.; Wurm; *Mammuthus primigenius* var. *sibiricus.*

59. **Marpod** (Sibiu district); unpublished upper teeth originating from terrace alluvia, near the cow ranch, found by C. Popescu in 1984; Bk.M.; Würm.

60. **Mediaş** (= Medgyes; = Mediasch, Sibiu district); Ackner (1850), Koch (1876, 1891, 1900), Goos (1876), Téglás (1886), Barbu (1930), Török (1933), Moga (1938), Nicolaescu-Plopşor (1938), Eufrosin (1942), Roska (1942), Samson & Herman (1968), Vörös (1983), Păunescu (2001); Târnava Mare Valley lower terrace; Würm.

61. **Mitoc** (Botoşani district); Necrasov & Ştirbu (1987), Simionescu (1990); at „Malu Galben" and „Istrati Creek"; in Compared Anatomy Collection, Iaşi University; Würm, possibly Gravetian; *Felis spelaea, Ursus* (?), *Cervus elaphus, Rangifer tarandus, Bos primigenius, Bison priscus, Equus transilvanicus, Equus* sp., *E. (Asinus) hydruntinus.*

62. **Motiş** (Valea Viilor township, Sibiu district); Török (1933).

63. **Nandru** (= Nándor, Peştişu Mic township, Hunedoara district); Téglás (1887), Koch (1900), Gaal (1928), Nicolaescu-Plopşor et al.(1957 b), Jungbert (1982), Cârciumaru (1980); Păunescu (2001); Curată Cave alluvia; A.I.B., D.R.H.C.M.D.; Würm, Mousterian II and I; *Megaloceros giganteus, Crocuta spelaea, Ursus arctos, Capra hircus, Ovis aries, Capreolus capreolus, Sus scrofa, Equus primigenius, Cervus elaphus, Castor fiber, Meles meles, Lepus timidus, Bos primigenius, Bos ursus, Bos taurus, Vulpes vulpes.* According some opinions, this list includes fossils originating from different levels *i.e.*, a mixture.

64. **Negrileşti** (Munteni township, Tecuci, Galaţi district); Macarovici & Costeski (1973); Bârlad River lower terrace; Würm.

65. **Ocna Sibiu** (Sibiu district); unpublished fossil collected in 1900; Bk.M.; Würm.

66. **Odorheiu Secuiesc** (Harghita district); Păunescu (2001); from 12-15 m Târnava Mare terrace; ? Würm.

67. **Ohaba-Ponor** (Pui township, Hunedoara district); Gaal (1928, 1943), Roska (1930 a, b, 1942, 1943), Voiteşti (1936), Moga (1938), Bombiţă (1954), Nicolaescu-Plopşor et al. (1957 c), Liteanu & Ghenea (1966), Dumitrescu et al. (1967), Cârciumaru (1980), Jungbert (1982); Păunescu (2001); Bordul Mare Cave alluvia; H.M.B., R.H.C.M.D.; Mousterian I-II-III; *Ursus spelaeus, Crocuta spelaea, Bos primigenius, Ovis argaloides, Saiga tatarica, Bison priscus, Mammuthus primigenius, Cervidae, Lutra lutra.*

68. **Oradea** (= Nagyvárad, Bihor district); Jurcsák (1970, 1974), Codrea & Gherdan (1990), Păunescu (2001); clay brick factory, near East Oradea railroad station; T.C.M.;

Würm; *Mammuthus primigenius, Equus germanicus, Cervus elaphus;* „kitchen midden", according Jurcsák.

69. **Ormeniş** (= Marosormenyes, Mirăslău township, Alba district); Téglás (1887), Koch (1891, 1900), Barbu (1930), Nicolaescu-Plopşor (1938), Eufrosin (1942); Würm; Ai.M.; *Mammuthus primigenius, Alces alces, Bison priscus.*

70. **Padea** (Drănic township, Dolj district); Apostol (1976), Apostol & Costăchescu (1981), Păunescu (2000); Jiului Valley alluvia, at „Prundu Jiului", reworked; O.C.M.; Würm; *Bison priscus.*

71. **Paşcani** (Iaşi district); unpublished mandible from Siret River alluvia; I.U.N.H.M.; Würm.

72. **Păcureni** (= Pókakeresztúr, Glodeni township, Mureş district); Koch (1876, 1891, 1900), Goos (1876), Téglás (1886), Moga (1938), Roska (1942), Vörös (1983), Codrea & Botoş (1995), Păunescu (2001); P.S.U.B.B.M.; Würm.

73. **Pescari** (Caraş-Severin district); Terzea (1977, 1986); Păunescu 2001; Livadiţa cave alluvia, level IV, löess with human settlement; A.I.B.; Early Würm, Charentian; *Homo sapiens* ssp. (? *neandertalensis), Equus* sp., *Capra ibex, Cervus* sp., *C. elaphus, Ursus spelaeus, Crocuta spelaea, Lynx* cf. *lynx, Canis lupus, Vulpes vulpes. Lepus* sp., *Ochonta* cf. *pusilla, Lagurus lagurus, Microtus gregalis, M. aeconumus, M. nivalis, M. arvalis, Cricetulus migratorius, Cricetus cricetus, Spalax leucodon, Chiroptera* indet.

74. **Petreştii de Jos** (= Magyarpeterd, Cluj district); Jungbert (1982), Păunescu (2001); in Alb Hill, into a collapsed cave with two Paleolithic levels; in the late Dr. N. Vlassa private collection; the age is extremely disputed: in some opinions Early or Middle Pleistocene, with „*Elephas antiquus* and *Rhinoceros antiquus (sic!), Equus stenonis*". Probably Jungbert's opinion is the right one, indicating either Riss/Würm or Early Würm.

75. **Poarta Albă** (Constanţa district); Ionesi (1994); from löess; probably Würm.

76. **Poiana** (Vorona township, Botoşani district); Macarovici & Costeski (1973); in löess; Würm.

77. **Proştea Mare** (= Grossprobstdorf, Sibiu district); Phleps (1926); Török (1933); Bk.M; Würm.

78. **Racoşu de** Jos (= Alsorakos, Brasov district); Koch (1876, 1891, 1900), Goos (1876), Téglás (1886), Barbu (1930), Török (1933), Moga (1938), Nicolaescu-Plopşor (1938), Roska (1942), Eufrosin (1942), Ilie (1958), Vörös (1983), Păunescu (2001); P.S.U.B.B.M.; Würm; *Mammuthus primigenius.*

79. **Radovan** (Dolj district); Apostol (1976), Păunescu (2000); O.C.M.; Würm.

80. **Rahău** (= Rehó, part of Sebeş town, Alba district); Koch (1891, 1900), Barbu (1930), Nicolaescu-Plopşor (1938), Eufrosin (1942), Roska (1942), Vörös (1983), Păunescu (2001); from Căşilor Valley; P.S.U.B.B.M., S.M.; Würm; *Ursus spelaeus, Mammuthus primigenius, Bos priscus.*

81. **Râşca** (Suceava district); Macarovici (1938), Eufrosin (1942); from the old Veniamin Costache's collection; the bones served for weights for draw beam of a well; N.H.I.U.M.; ? Würm.

82. **Reci** (= Réti, Covasna district); Kovács (1981); from Negru River terrace; Sf.Gh.M.; Würm.

83. Remetea; (Mureş district); Moga (1938).

84. **Ripiceni Izvor, Stânca Ripiceni, Ripicenii noi** (Botoşani district); Eufrosin (1942), Liteanu & Ghenea (1966), Macarovici & Costeski (1973), Cârciumaru (1980), Trelea & Sficlea (1983), Necrasov & Ştirbu (1987), Simionescu (1990); Pruth River lower terrace; Compared Anatomy Collections, Iaşi University; Würm; *Mammuthus primigenius, Bison priscus, Bos primigenius, Felis spelaea, Crocuta spelaea, Vulpes vulpes, Canis lupus, Cervus elaphus, Capreolus capreolus, Rangifer tarandus, Equus transilvanicus, Eq. hemionus, Eq. (Asinus) hydruntinus, Lepus timidus, Marmota bobac.*

85. **Râpa** (Tinca township, Bihor district); Jurcsák (1974), Csák (1978), Jungbert (1986), Codrea & Gherdan (1990), Păunescu (2001); in the sediment infilling of an ancient hyena den, in Burzău Hill; Ti.M.; Late Würm; *Mammuthus primigenius, Megaloceros giganteus, Equus germanicus, Felis spelaea, Ursus spelaeus, Erinaceus europaeus, Talpa europaea, Sorex araneus, Crocidura leucodon, Ochonta pusilla, Lepus europaeus, Citellus citellus, Marmota* cf *bobac, Apodemus sylvaticus, A. flavicollis, Cricetus cricetus, Clethrionomys glareolus, Arvicola terestris, Microtus gregalis, M. oeconomicus, M. arvalis, Vulpes vulpes, Mustela erminea, Putorius putorius.*

86. **Roşia** (Bihor district); Jurcsák (1974), Codrea & Gherdan (1990), Păunescu (2001); B.M.T.

87. **Roşia Săsească** (= Veresmart; = Rotberg, Sibiu district); Ackner (1850), Koch (1876, 1891, 1900), Goos (1876), Barbu (1930), Moga (1938), Nicolaescu-Plopşor (1938), Roska (1942); Bk.M.;

88. **Sânelisabeta** (Cluj district); Barbu (1930), Nicolaescu-Plopşor (1938), Eufrosin (1942). Probably name confusion, this locality does not exist in Cluj district, perhaps it is a vicious translation of a German or Hungarian toponym.

89. **Sângeorgiu** (Turda); Barbu (1930), Eufrosin (1942). Another similar problematic toponym. It could be Sângiorgiu de Câmpie, from Mureş, district.

90. **Sângeorgiu de Mureş** (Mureş, district); Fuchs & Konya, 1967; Codrea & Botoş. (1995); Würm.

91. **Sebeşul Săsesc** (= Szaászsebes, Alba district); Koch (1891, 1900), Barbu (1930), Nicolaescu-Plopşor (1938), Eufrosin (1942), Roska (1942), Vörös (1983), Păunescu (2001); the fossils had been curate at Sebeş gymnasium, where they disappeared; probably Würm; *Capreolus capreolus, Sus scrofa, Equus* sp., *Bos* sp.

92. **Sf. Gheorghe** (= Sepsiszentgyörgy; = Sankt Georgen, Covasna district); Koch (1886, 1891, 1900), Téglás (1887), Barbu (1930), Moga (1938), Nicolaescu-Plopşor (1938), Roska (1942), Liteanu et al. (1962), Radulesco et al. (1965), Patrulius & Mihăilă (1966), Bandrabur (1967), Alimen et al. (1968), Samson et al. (1969, 1973), Samson & Kovacs (1970), Macarovici (1972), Samson (1975), Kovacs (1981), Rădulescu & Samson (1985), Păunescu (2001); older finds without clear stratigraphy; for the new finds from „Cariere sud": levels A and B1 (both with andesitic clastic rocks) and löess; Sf.Gh.M.; Mindel (A), Riss/Saale, Riss I and II (BI), Würm (löess); *Mammuthusprimigenius, Equus insulidens.*

93. **Sibiu – Guşteriţa** (= Szenterzsébet; = Hammersdorf, Sibiu district); Ackner (1850), Hauer & Stache (1863), Koch (1876, 1891, 1900), Goos (1876), Téglás (1887), Phleps (1926), Moga (1938), Ilie (1958), Vörös (1983), Păunescu (2001); the fossils originated from Venczel and Remeta creeks, found in alluvia; it seems that these fossils have been lost; probably Würm; *Bos priscus, Cervus elaphus, Dama dama, Capreolus capreolus, Equus primigenius* as well some strange mentions: „*Hippotherium nanum, Tapirus giganteus, Elephas priscus*" (according Ackner). According Păunescu (2001), the paleontologist P. Samson restricted the list to: *Mammuthus primigenius, C. antiquitatis, Equus spelaeus* (dominance), *E. transylvanicus* (very rare), *Cervus elaphus, Megaloceros giganteus, Alces alces, Bison priscus.*

94. **Sândominic** (= Csikszentdomokos, Harghita district); Samson & Rădulescu (1969), Rădulescu & Hermann (1971), Rădulescu & Samson (1985), Păunescu (2001); from karst filling, in travertine open pit, upper level (2); E.R.S.I.B.; Late Pleistocene, Riss/Saale, Riss I and Riss II; *Equus steinhaimensis, Eq. insulidens, Cervus elaphus, Rangifer tarandus, Bison priscus, Ursus spelaeus, Sorex* sp., *S. minutus, Citellus citelloides, Sicista subtilis, Apodemus sylvaticus, Clethrionomys glareolus, Lagurus lagurus, Arvicola terrestris dominici, Microtus nivalis, M. oeconomus, M. arvalis, M. agrestis, M. gregalis* cf. *martelensis, Ochonta pusilla.*

95. **Sângeorgiu de Mureş** (Mureş district); Fuchs & Konya (1967); from Mureş River lower terrace; Würm.

96. **Sânpaul** (Mureş district); Codrea & Botoş (1995); from III Mureş River terrace, near the railroad station in a gravel open pit, found in 1982; Tg.M.M.; Würm.

97. **Someşul Rece** (Gilău township, Cluj district); Kormos (1914), Jungbert (1986); fossils collected by Koch in 19th century, determined by Kormos; Cetate Cave alluvia; material lost or probably into a Hungarian collection; Würm; according Koch, the list of taxa includes: *Capra ibex, Rupicapra rupicapra, Bos* sp., *Canis* sp., *Vulpes vulpes, Marmota bobac, Cricetus frumentarius, Arvicola terresteris.* Kormos added some more taxa, the list final including 19 mammal genera.

98. **Stejărişu** (= Prépostfalva; = Propstdorf, Iacobeni township, Sibiu district); Koch (1876, 1891, 1900), Goos (1876), Téglás (1886); Bk.M.; Würm.

99. **Strei-Sângeorgiu** (= Sztrigyszentgörgy, Calan town, Hunedoara district); Koch (1876, 1891, 1900), Goos (1876), Téglás (1886), Gaal (1928), Roska (1942), Vörös (1983), Păunescu (2001); fossils once curate in Ardelean Museum collection, now lost; Würm.

100. **Subpiatră** (Ţeţchea township, Bihor district); Jurcsák (1974), Codrea & Gherdan (1990), Păunescu (2001); from Subpiatra Cave alluvia; T.C.M.; Würm.

101. **Sulina-Canal** (Tulcea district); Antipa (1912), Ciocârdel & Protopopescu-Pache (1955), Nicolaescu-Plopşor (1959 b), Liteanu & Pricăjan (1963), Liteanu et al. (1963), Oncescu (1965), Liteanu & Ghenea (1966), Mihailăscu & Rogojină (1984); from Danube drags at 12 mile, 3-7 m depth, probably from the löess underlying the recent alluvia; Gr.A.M.; Würm; *Mammuthus primigenius, Equus* sp.

102. **Şardul Unguresc** (= Magyarsárd, Sânpaul township, Cluj district); Barbu (1930), Moga (1938), Nicolaescu-Plopşor (1938), Eufrosin (1942), Roska (1942), Jungbert

(1986), Păunescu (2001); from a location called Dealu de Veghe (Orhegy), found in 1877; fossils once in Ardelean Museum collections, now lost; Würm.

103. **Şeica Mare** (= Nagyselyk, Sibiu district); Téglás (1887), Koch (1900), Barbu (1930), Moga (1938), Nicolaescu-Plopşor (1938), Eufrosin (1942), Kovacs (1981), Vörös (1983); old discoveries originating from Viza Valley; a lot of fossils lost, but two teeth are in Sf.Gh.M.; Würm.

104. **Şomartin** (= Mártonhegy; = Martinsberg, Bruiu township, Sibiu district); Ackner (1850), Koch (1876, 1891, 1893), Téglás (1886), Goos (1876), Barbu (1930), Moga (1938), Nicolăescu-Plopşor (1938), Eufrosin (1942), Roska (1942), Vörös (1983), Păunescu (2001); according Téglás, these fossils existed in Braşov College collection, now lost; Würm; *Mammuthus primigenius*.

105. **Tecuci – Rateş** (Galaţi district); Papadopol & Barbu (1933), Obreja (1956), Macarovici & Jeanrenaud (1958), Macarovici (1959, 1968), Apostol & Vicoveanu (1970), Macarovici & Costeski (1973), Apostol (1976), Băcăuanu (1978), Simionescu (1990); from Bârlad River lower terrace probably reworked from higher terraces, in gravels; Tc.ML; Würm; *Mammuthus primigenius, Equus germanicus, E. scythicus, Camelus* sp., *Bison prisons, Bos primigenius, Sus scrofa ferus*.

106. **Teliu** (= Keresztvár; = Kreuzburg, Brasov district); from Cioarei Creek, collected by the geologist D. Ciupagea in 1927; in ROMGAZ MEDIAŞ S.A. collection; Würm.

107. **Timişoara** (Timiş district); Codrea & Gherdan (1990); from Timişoara town environs; B.M.T.; Würm.

108. **Târguşor** (Constanţa district); Dumitrescu et al. (1963), Macarovici (1968), Rădulescu & Hermann (1971), Samson et al. (1973), Cârciumaru (1980); form La Adam Cave, VII layer; E.R.S.I.B.; end of Gotweig interstadial; *Mammuthus primigenius, Crocuta spelaea, Apodemus sylvaticus, Cervus elaphus, Bos primigenius, Ursus spelaeus* etc.

109. **Târgu Secuiesc** (= Kézdivásárhely; = Neumarkt, Covasna district); Bandrabur (1967), Păunescu (2001); on Turia Creek; in private collection; Late Pleistocene, without other details.

110. **Turzun** (= Freitum bei Reps, part of Hoghiz village, Brasov district); Phleps (1926); from löess; Bk.M.; Würm.

111. **Ţapu** (= Abstdorf, Micasasa township, Sibiu district); Phleps (1926); Bk.M.; Würm.

112. **Zerindu Mic** (Arad district); Codrea & Gherdan (1990); T.C.M.; Würm.

Coelodonta cf. *antiquitatis* sites

1. **Bodoc** (Covasna district); Kovacs (1981); Riss/Saale, Riss I and Riss **II.**

2. **Sândominic** (Harghita district); Bandrabur & Codarcea (1972), Paunesco et al. (1982); see *C. antiquitatis*.

Coelodonta sp. sites

1. **Feldioara** (Braşov district); Kovacs (1981); from brick factory clay open pit; Sf.Gh.M; Mindel.

2. **Ghidfălău** (Covasna district); Samson & Kovacs (1970), Samson et al. (1973), Kovács (1981); see *C. antiquitatis.*

3. **Sf. Gheorghe** (Covasna district); Samson & Kovacs (1970), Samson et al. (1973), Kovacs (1981); see *C. antiquitatis.*

Rhinocerotidae indet., probably belonging to *Coelodonta*

1. **Boroşteni** (Peştişani township, Gorj district); Terzea (1987); from Cioarei Cave, layer 9, a cold event between Moeshoofel and Hengelo interstadials; E.R.S.I.B.; *Spalax leucodon, Lepus* sp., *Ursus arctos, Sus scrofa, Cervus elaphus, Capra ibex.*

2. **Holboca** (Iaşi district); Macarovici & Zaharia (1963), Macarovici (1968), Zaharia et al. (1970), Chirică & Tanasachi (1984); from Bahlui River lower terrace (10 m), at Izvorul Pândarului; Würm; *Mammuthus primigenius* (initially assigned to „*Elephas trogontheri*" by Macarovici), found with terrestrial snails and Mousterian-type stone tools; H.M.I.

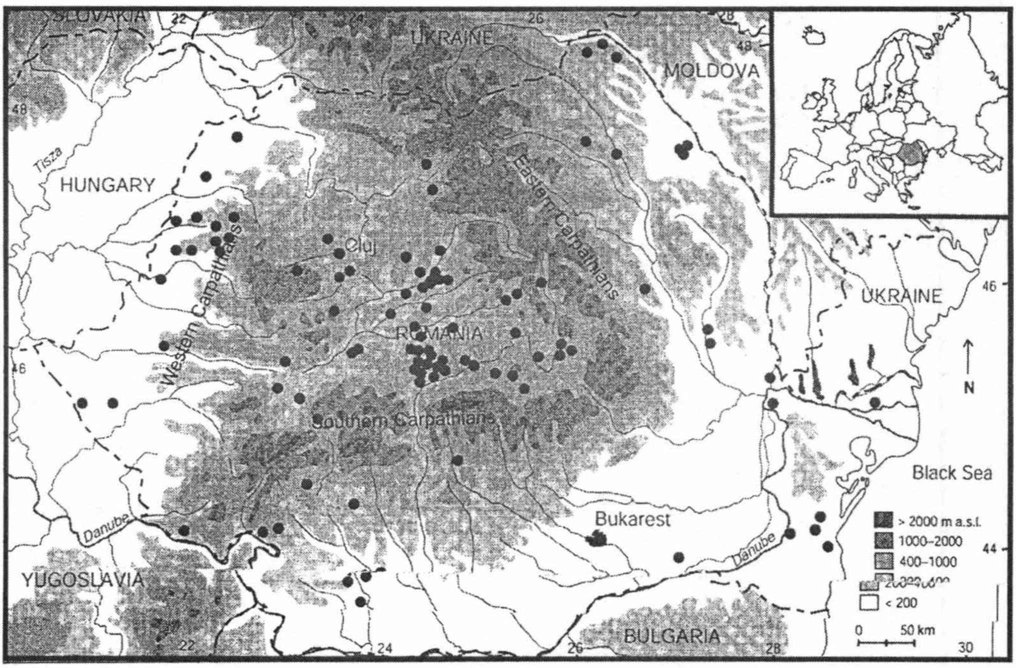

Fig. 2. Distribution of main wooly rhino localities in Romania

Conclusion

The woolly rhino occurred in our country since the Middle Pleistocene, beginning with the Mindel glacial. Probably it was an immigrant originating from eastern regions, arriving in this part of Europe due to the cold Mindel episode. The Mindel representatives are scarce in the fossil record, as well as the Riss ones. However, this scarcity is probably due rather to the rare Middle Pleistocene formations in Romania. In the Late Pleistocene

(Würm) the number of localities with wooly rhino is considerably high, reflecting the density of the populations. As in other European areas, the Late Pleistocene rhinos occurred together with mammoth *(Mammuthus primigenius)*, bison *(Bison priscus)*, horses *(e.g. Equus transylvanicus)* or giant deer *(Megaloceros giganteus)*. This association indicates the cold episodes of the last glacial.

A lot of localities lack clear stratigraphy: this is a task for the future discoveries and interpretations, in order to refine the knowledge about this Ice Age large mammal and its evolution in our country.

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Studii şi cercetări, Geologie-Geografie 10, 2005, Bistriţa, p.33-37

„LA GRANDE COUPURE", MAIN CENOZOIC BIOEVENT

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Abstract. After his studies on the Paleogene mammals assemblages from Paris Basin (France), the famous vertebrate paleontologist Stehlin introduced the name„*La Grande Coupure*" (abbreviated LGG), in order to point out a major turnover in the evolution of these assemblages. Later studies on European Paleogene terrestrial biota confirmed this event related to main global changes passed around Eocene/Oligocene boundary.
Key-words: Cenozoic event, „*La Grande Coupure*", Eocene/Oligocene boundary, terrestrial biota.

Introduction

Worldwide, the Paleogene has been marked by a series of dramatically turnovers concerning the evolution of flora and fauna assemblages, due to the paleoclimatic and paleogeographic changes. However, the most outstanding evolution fractures took place in Europe, where large categories of various taxa disappeared around Eocene/Oligocene boundary.

These biota changes can be compared with other major representative bioevents as for example the Cretaceous/Paleocene (K/T) or Paleocene/Eocene boundaries. Such events are extremely useful for correlations in stratigraphy.

„*La Grande Coupure*" (LGG) is a concept first time introduced by Stehlin (1909), studying the Paleogene mammal assemblages from Paris Basin (France). He observed a sudden disappearance of the Eocene European endemic taxa and the occurrence in Oligocene of several representatives originating from Asia. The name introduced by Stehlin is extremely suggestive, indicating the abruptness of the faunal turnover recorded mainly by European vertebrates at Eocene/Oligocene boundary.

Control factors and effects

If we must interpret the Paleogene climates, one have to accept that this period means a transition between the Upper Cretaceous warm climate and the increasing cold Neogene tendency (Berggren & Prothero, 1992).

The Middle Eocene – Early Oligocene interval, extended on 10 M.y., seems had been a critical phase in the geological history of the Earth. The decrease of annual mean values induced by the cooling tendency put an imprint on flora and fauna assemblages, recorded mainly by terrestrial taxa.

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Two cooling phases can be distinguished by floristic studies. The first one followed the warm Middle Eocene (41-40 M.y.); with ca. 10°C drop of annual temperature mean value, and the second one, which followed the Upper Eocene warming (33-32 M.y.), with at least 13°C drop. This entire climatic cooling interval called by Woolfe (1971) the „Oligocene deterioration", and later by the same (Woolfe, 1978), the „Terminal Eocene Event" (abbreviated T.E.E.).

As a consequence, there are two low temperatures phases leading on an aridity increase: the first at the top of the Middle Eocene; the second one covered the Eocene/ Oligocene boundary extending to the Early Oligocene (Berggren & Prothero, 1992).

The *causes* invocate for these major climate changes are in connection with the tectonic events, which affected the global oceanic circulation of waters, splitting apart Australia from Antarctica and Norway from Greenland (Prothero, 1985). The opening of the passage between Antarctica and Australia established the occurrence of the Antarctic „ice sheet" (Kennett et al., 1975), the first such event ever recorded in Cenozoic. According to Hooker (2000), this „ice sheet" would be responsible for the sea level drop. Unfortunately, the first moment of the ice sheet installation remain still unclear. Consequently, the first cooling phase is still waiting for an explanation. Bartek et al. (1992), proposed a pattern, which explains the development of the Antarctic „ice sheet" as a consequence of the evaporation and precipitation of waters conveyed towards Antarctica from the equatorial regions of the Pacific Ocean.

The changement of the Paleogene paleogeography putting apart Australia from Antarctica, facilitated the development of circum-Antarctic stream, which is responsible for the Antarctic glaciation (Kennett, 1977).

The consequences of the climate cooling radically altered the evolution of the flora and fauna from the Northern Hemisphere.

Land flora and fauna changements in Europe

Flora changements. The palynological analyses (Collinson, 1992) suggested for the Eocene a general turnover in the flora composition. The floristic studies indicated a transition from dominantly tropical vegetation in Middle Eocene to subtropical vegetation in Late Eocene. The climatic deterioration continued even in Early Oligocene, marked by mixed deciduous and evergreen forests, indicating the presence of warm temperate and seasonal climate.

The vegetal transition from the tropical to the subtropical and warm temperate evolved in paralell with an increase in aridity. The well represented *Ephedra* from the Late Eocene is a hard evidence, besides the increased frequence of silcrets and calcretes (Daley, 1989), or the mammals indicating wide open areas (Hooker, 1992).

In this manner, from the exuberant Middle Eocene forests, in the Early Oligocene one can record a lot of areas with a more attenuate vegetation, involving open grassy areas interropted by clusters.

Faunal changements. In Europe, the data concerning flora and fauna changes referred to LGC in the different regions are very uneven. The details are usualy missing because of rarity of convenient exposures recorded in the field.

In Eocene, Europe looks like an archipelago. On its shores, the marine sequences interbedded with the terrestrial ones (Berggren & Prothero, 1992). However, LGC is well marked on a lot of Western Europen Paleogene sections that alloowed adequate calibrations for biostratigraphy.

The Lower and Midle Eocene European faunas are dominated by archaic.taxa as: multituberculates, „adapiform" primates, creodonts, „insectivors", archaic ungulates, pantodonts and tillodonts (Berggren & Prothero, 1992). Among perissodactyls one can enumerate paleotheres and lophiodonts, while among artiodactyls: choeropotamids, xiphodonts, mixtotheriids, cebochoerids, anoplotheriids, dacrytheriids, cainotheriids and amphimerycids.

A turnover top, associated to the Bartonian-Priabonian event (Hartenberger, 1984) lead to major extinction of perissodactyls. These ones was replaced by *Palaeotherium* representatives with a peculiar dentition adapted to coarse-browsing. Than, one can record the decrese of: tree-dwellers taxa, mainly among apatemyis and primates, the insectivores and the small mammals (Collinson & Hooker, 1987). The rodent fauna ballance betwen pseudosciurids and theridomyids.

Beginning with the Oligocene, the Turgai Strait became a passageway, so that the insularity of Europe had gone (Wang, 1992). The track, from an immigration center located in SW Asia, followed the Balkan archipelago towards the Alps highs already outlined after the Upper Cretaceous tectogenesis (Heissig, 1979). In this respect, one can suspect several ways of immigration from Asia towards Europe, the Anatolian/Balkan one being just one of them.

On these land bridges, a lot of representatives of various asiatic groups as: Lagomorphs, Cricetids, Rhinocerotidae, Zapodidae, Chalicotheriidae, Entolodontidae etc., was able to immigrate in Europe. The post-„LGC" fauna involves: hares, evolved carnivors (especially amphicyonids, viverids, mustelids, ursids, procyonids and nimravids), theridomyid rodents, evolved artiodactyls (anthracothers, entelodonts, leptomerycids and tayassuids), as well as perissodactyls (chalicothers and rhinocerotoids). It worth to be mentioned the dominance of large-sized mammals and the extinction of tree-dwellers, besides the first ocurrence of seed eating rodents.

The newcomers were nothing else but the ancestors of modern faunas. Their success has to be explained by the extinction of the old endemic groups, unable to adapt to this new constraint (Hartenberger, 1983).

If outlining a review of fauna preceding the great LGC immigration, one can point out that these are poor and low diverse (Hartenberger, 1983). Compared to the Eocene, in Oligocene one can notice several new aspects as: 60% impoverishment of land vertebrates; significant decrease of mammal sizes; the occurrence at the beginning of the Oligocene of 13 new mammal families arrived from Asia (Brunet, 1977; Cavelier, 1979; Russel et al., 1982). All these changes can be interpreted as a consequence and answer to paleoclimate and paleogeography mutations issued in this time span.

This famous faunal turnover was extremely well represented in Western Europe. It is mainly a bioevent related to Europe: in Asia, as well as in North America, there are much more interesting bioevents, as the ones from Chadronian/Orellan (= Bartonian/Priabonian) boundary or the ones occurred along all the Orellan (= Early Oligocene; Hooker, 2000).

Conclusions

A lot of analysis done either on Paleogene flora or fauna across the Eocene/Oligocene boundary revealed a deep turnover into the assemblage structures. As a consequence of results on the Western Europe fauna, this event got a name: – „*La Grande Coupure*", introduced by Stehlin (1909). All these changes resulted as a consequence of significant climatic deterioration, which induced a strong aridity and a decrease of annual mean values, as well as tectonic events.

The main consequence in Western Europe referred to the already famous faunal turnover: the autochthonous representatives should to leave the place to newcomers originating from Asia. This immigration automatically involved a sharp change, or moreover the beginning of a decline in European vertebrate fauna continuity. The Asiatic newcomers replaced in very short time the endemic European representatives. This bioevent is confirmed in all Europe, but the first moment of this replacement is however different, depending on the different regions: earlier in the East side of the continent (Romania and Bulgaria), delayed westwards, as succeeded the immigration waves.

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MINERALOGY, PETROLOGY

Studii şi cercetări, Geologie-Geografie 10, 2005, Bistriţa, p.41-46

GLOBULAR CRYSTAL AGGREGATES IN THE JAMESONITE ASSEMBLAGE

Virgil GHIURCĂ[1]

Abstract. The paper describes several types of **globular aggregates of loose** (floating, matrix-free) **crystals** that formed in the jamesonite-containing geodes of diameters between 0.5 to 9.5 cm, of which some are half white and half black, thus being very aesthetic. These aggregates have formed due to strong turbulent flows within the geodes, of high density mineralizing solutions and to the existence of an extremely porous environment represented by the woolly jamesonite aggregate in suspension. A globular iridescent siderite aggregate is described, including considerations on this type of optical effects related to gems. In this particular „concretion" type the iridescence may be related to light interference on a thin layer of a different material that was deposited at the surface of siderite idiomorphous crystals.
Key words: concretion-type crystal aggregates, iridescent siderite „concretion", iridescence

The jamesonite-containing geodes present in the mines from Baia Mare region host an extremely rich mineral association, that may be grouped into idiomorphous crystals formed in suspension in the jamesonite wool (quartz, calcite, siderite, dolomite, sphalerite, tetrahedrite etc.), rare forms of curved microcrystals of jamesonite (transitional shapes, elliptical, ring-like, disk-like, cylindric, etc), as well as globular **aggregates of loose crystals consisting of carbonates** – in most of the cases formed in suspension, i.e. they do not have a rock matrix. Such jamesonite geodes and „concretions" are more frequent in the mines from Herja and Baia Sprie, and rarely at Sasar, Cavnic etc.

In general, the geological term **„concretion"** denotes local agglomerates of minerals with a **concentric or zoned massive structure,** formed by **centrifugal growth** around a central nucleus during the diagenesis of sedimentary (sandstones, for example Sarmatian deposits, clays or carbonates) deposits; they are considered to represent diffusion, precipitation or dehydration structures, as a rule showing spheroidal-ellipsoidal shapes. It is obvious that these „genuine" concretions are of a clearly distinct genesis as compared to the **globular aggregates formed in the geodes of the hydrothermal veins.**

The globular aggregates formed in the jamesonite – previously known as „plumosite" – geodes' association consist of aggregates of mainly idiomorphous crystals of calcite, siderite, ankerite and rarely quartz, sphalerite and galena. To conclude, the spherical-ellipsoidal, or sometimes irregular „concretions" are composed of idiomorphous carbonate crystals showing a centrifugal growth pattern.

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Of a special interest for the mineral collectors are the loose **globular calcite aggregates** – built-up of well-defined rhombohedral crystals clearly individualized at the aggregates' surface – with diameters between 1 to 9.5 cm. Sometimes the aggregates and half white and half black, the latter being the result of the numerous fine acicular jamesonite inclusions in the white calcite. This selective coloring indicates the crystallization of the aggregate at the limit between the jamesonite-containing and the jamesonite-free environments. More frequently the calcite concretions are black, as a consequence of their formation in a jamesonite-rich solution.

In some cases the **calcite „concretion"** is pear-shaped, with the lamellar, slightly curved crystals are usually brownish (average sizes: 6 cm in length, and 2-4 cm in diameter). On the surface of this concretion type a distinctive, small area of poorly-developed calcite crystals indicates the proximity of a jamesonite-rich matrix that prevented an active circulation of solutions. In this particular area, acicular jamesonite crystals or idiomorphous loose quartz, dolomite or siderite crystals were noticed (Photo 1 a).

Another type of **calcite globular „concretion"** (with diameters of 2 cm) consists of idiomorphous calcite crystals showing a particular, elongated crystal facies, that are slightly translucent and greyish. Rarely, at the surface of these aggregates, minute rhombohedral white crystals of siderite and acicular crystals of jamesonite at the limits between the crystals are present (Photo 2b).

In some cases the **calcite aggregates** are smaller (1-2 cm), are irregular in shape and are slightly elongated, with lateral spherical overgrowth consisting of vacuolar curved (probably partly dissolved) carbonate microcrystals, intimately associated with idiomorphous quartz crystals of the „Maramureş diamonds" type from the Cretaceous sedimentary formations from Bocicoiu Mare; however, the former are not so clear and transparent and some of them contain inclusions of acicular jamesonite (Photo 3a).

Scarce **aggregates of bonded idiomorphous quartz crystals** were also noticed, resembling platy „concretions", with average sizes of 18 x 4 x 0.8 cm and average weight of 150 g. They formed within the jamesonite wool that consisted a dense and porous environment, resistant enough to support the weight of the various types of concretions; usually these concretions are loose, thus show no matrix, and they can be easily detached from the jamesonite wool (Photo 4a, d). In the same environment, idiomorphous loose or paired calcite crystals occur (Photo 4b, c, e, f; Photo 6).

Rarely the jamesonite geodes contain **loose black globular aggregates** that may be **single,** double **(bi-lobated)** or triple **(tri-lobated),** each being 0.3 mm to 3 cm in diameter, containing isolated idiomorphous **ankerite** crystals on their surface. The black colour is due to the numerous jamesonite inclusions (Photo 2a, c, d, e; Photo 3b, c, d, e, f, g). Some of these loose concretions might have been incorporated after their formation in calcite or siderite masses giving birth to complex aggregates (Photo 5).

Less frequent are the black hemispherical „concretions" fixed in a matrix, that mainly consist of black calcite crystals with galenite and minor sphalerite, and marcasite-pyrite in the base. Besides calcite, black idiomorphous sphalerite (marmatite variety) or rarely cleiophane (translucent, gem-quality sphalerite), idiomorphous quartz microcrystals, tetrahedrite and obviously acicular jamesonite may be present on the surface of the hemisphere. The average sizes are: 5 cm diameter, 3.3 cm height (Photo 1b).

However, **genuine globular concretions** (similar to those typical for sedimentary deposits) also occur rarely; they are grey-brownish, ~3.5 cm in diameter, and show no individual crystals at the surface. They consist of a **concentric-lamellar display of siderite,** 4-5 mm thick. The **inner part of this concretion type** – first mentioned and described by Mârza (2004) **is empty,** however it may still contain rare loose rhombohedral siderite microcrystals.

Another **concretion variety** of the same type has a very thin external cortex, about 1 mm thick, and contains in the inner part small, loose aggregates of crystals. The genesis of such „**hollow" concretions** was related to the presence of large gas bubbles within the high density (and viscosity) mineralizing solution, that was surrounded by successive siderite pellicles.

The most interesting globular crystal aggregate, only 1.2 cm in diameter and grey-black in colour, identified in the jamesonite geodes consists of very well-individualized, **slightly curved siderite crystals.** When observed in transmitted light, the crystals prove to be greyish, slightly translucent and they contain rare acicular jamesonite crystals. The external faces of the well-developed crystals are covered by micron-sized lamellar layers of a different material, giving birth to **spectacular iridescence.** Under various, small angles, this effect is materialized by **changes from metallic blue to metallic red** colours, similar to the tarnish colours of oxidized chalcopyrite or partly bornite (in the case of blue) surfaces (Photo 8). Rare tiny, white rhombohedral dolomite crystals were noticed at the surface of the siderite crystals, while in-between the siderite crystals acicular, or even ring-shaped iridescent jamesonite crystals are present (Photo 7, Photo 5f). In a single sample of jamesonite from Herja about **10-15 iridescent globular aggregates of similar sizes have been identified.**

We relate the genesis of such globular crystal aggregates and that of „hollow" concretions from the jamesonite assemblage to the synchronous existence of very strong turbulent currents in the geodes associated to a very high density of the mineralizing solutions, and correlated with the porous but still dense environment created by „plumosite". These overlapping circumstances converged to the formation in suspension of such hydrothermal „concretions". Our hypothesis is also confirmed by the presence in the same assemblage of numerous loose idiomorphous crystals, also formed from suspensions, or of aberrant loose curved sub-millimetre microcrystals of jamesonite of various shapes (elliptic, ring-like, cylindric etc.).

The highly aesthetic iridescence of the surface of the siderite crystals, however questionable from the genetic point of view, imprints them a gemologic appearance. We performed an experiment consisting in the acid etching of the crystal surface, by using diluted HCl. The result was the complete disappearance of the iridescent effect, thus leading us to the conclusion that the effect is due to a very thin film that is soluble in HCl. Water retrieves the iridescence only temporarily, while the superficial abrasion of the crystal surface by using a blade leads to the definitive ceasing of the optical effect. Similar iridescence was noticed also on some very well-crystallized stibnite samples from Herja and Baia Sprie, which, according to some authors (note of the editor to Ghiurca, 1966) is due to **a distinctive mineral phase called „irisatite"**, but to which a corresponding chemical composition was not assigned and, officially, it is not a valid species.

For explaining the iridescence noticed on the siderite concretions from the jamesonite-containing geodes from Herja we will briefly present below similar case studies included in a recent paper on the origin of colours in gems (Fritsch and Rossman, 2001).

In our case, the translucent siderite crystals apparently show a dark, black colour; when in motion, the concretion shows iridescent effects of the type resulted from light interference with some thin films at the surface of the crystals. These effects are different from the ones caused by diffraction along lamellar structures, as for example in the case of precious opal, labradorite („spectrolite") and less frequently of „rainbow"-type andradite. However, in both cases the colours are due to physical, optical effects.

The interference is produced when two light rays move along the same trajectory, or along very close or parallel ones. If the rays have the same phase they reinforce each other and give birth to a bright light called „constructive interference". On the contrary, if the rays are in opposite phase they neutralize each other, phenomenon known as „destructive interference".

Iridescence is the most common type of interference, obtained when light crosses a thin, transparent film with a diffractive index different from that of the main mineral (ex an air film caught within the „iris quartz"). The light reflected by the lower layer of the film and that reflected by the upper one vibrate along almost parallel directions. At specific wave length, in connection with specific thicknesses of the film or values of refractive indices, the rays are in opposite phases, thus the corresponding colours disappear as a result of destructive interference. The remaining wave length will create an optical effect similar to that produced by a hydrocarbon pellicle floating over water surface. None of these interference colours caused by optical effects of thin films will be „true" spectral colours.

Such iridescence effects are in fact a combination of several spectral colours (also known as the interference colours of Michel-Levy series). They can be also noticed in the case of fissured quartz („iris quartz") or in the oxidation products at the surface of minerals such as sulfides (chalcopyrite, pyrite, bornite) or oxides („rainbow" hematite) or Fe-hydroxides. The „orient" of pearls (an overtone colour present as a lustrous sheen at the surface of some natural pearls) is partly also due to iridescence. Similar effects can be noticed in the case of shell nacre, but the colours are much more lively, thus less subtle, probably due to a higher quality diffraction lattice.

The same effects may be obtained artificially, by producing cracks when heating quartz, or by adding superficial films of various compositions on diverse gem materials.

Further research is still needed for defining the chemical and mineralogical nature of the thin films covering the globular aggregates of siderite crystals from the jamesonite geodes. The mineral phase is present in such small amounts, that only point analytical techniques may be used successfully.

In the studied case interference produces colours with hues (metallic bluish and red-brownish) similar to those of chalcopyrite; thus, a working hypothesis may be that thin films of chalcopyrite may cover the siderite crystals. Similar iridescence effects have been also noticed on stibnite crystals from Herja or Baia Sprie mines, and rarely on sphalerite microcrystals in the jamesonite assemblage. In the same context, loose idiomorphous crystals of tetrahedrite-tennantite, 1-3 mm in size with slightly visible bluish iridescence and tiny aggregates of iridescent chalcopyrite crystals have been also identified.

The gemological literature mentions iridescence produced by thin films – showing a greasy or steamy appearance, only in the case of „iris quartz", of some pearl varieties (the so-called „orient" of pearls) and of the nacre of some oceanic shells *(Haliotis australis* in the Pacific area).

A special type of interference effects due to **diffraction** is also known in gemology. A complete range of physical effects was noticed between those produced by interference on a thin pellicle and diffraction along a series of fine layers, perfectly and regularly interlayered, showing various refractive indices, leading to the occurrence of pure spectral colours (similar to the rainbow colours). Typical examples include: precious opal, labradorite/ spectrolite (labradorescence) and some rare rainbow andradites (ex. from Mexico, Japan, and Romania).

Coloured optical effects may be obtained also in the case of some gem minerals with irregular internal structures that are not suitable for diffraction; in these cases light gives birth to **diffuse effects,** as in the case of moonstone (adularescence), some bluish quartz or opals (opalescence), or of some milky quartz varieties. Diffusion of light is also produced on some metallic nanoinclusions in gem minerals; ex. violet fluorite (calcium), or ruby (red) glass (inclusions of microcrystals of gold or copper).

Other causes of colours in gem minerals are related to the presence of coloured inclusions: the green colour of chrysoprase (microcrystalline quartz, i.e. chalcedony) and prase opal is due to inclusions of Ni-rich clay; the aventurine quartz owes its typical aventurescence to the inclusions of glistening Cr-rich mica (fuchsite); the red-orange colour of carnelian (microcrystalline quartz) and fire opal is due to Fe-oxides; a similar red colour in feldspar is imprinted by hematite and/or copper lamellae (sunstone); a bluish colour of quartz may be due to dumortierite inclusions.

Chatoyancy (cats' eye) or asterism in chrysoberyl, corundum, quartz and diopside are effects of the same nature. These phenomena are more obvious when the gemstone is cut as cabochon.

In conclusion, specific optical effects occur when light interacts with gem minerals showing peculiar physical characteristics, textures or internal structures. The new colours or colour effects cannot be caused or enhanced by artificial treatments, being intrinsic features of the gem material. They are not due to peculiar light adsorption phenomena, but to **light interference (diffraction or diffusion)** with the structure of the gem minerals, at a microscopic scale.

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Studii şi cercetări, Geologie-Geografie 10, 2005, Bistriţa, p. 47-51

PISOLITES OF MAGMATIC ORIGIN

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Abstract. After presenting the sedimentary ooids and pisolites and the corresponding genetic processes, some white, glossy pisolites collected from Cavnic mine are morphologically described. These hydrothermal pisolites are usually ovoidal and consist of a sulfidic core (galena, sphalerite, pyrite) with carbonates, and a cortex built-up of successive Ca-carbonate laminae. The pisolites from Cavnic formed from agitated carbonate-rich solutions, as void-type deposits embedding sulfide-containing, broken vein fragments, in a similar way with the genesis of cave pearls.
Key words: hydrothermal pisolites, morphology, genesis.

Pisolites in the magmatic domain presented in this study were gathered by the amateur collector Mozes Iosif from Cavnic (former member, now deceased, of the Association of amateur mineralogists, paleontologists and gemologists from Romania, AMPGAR) from local miners; Mozes Iosif used to be a fine observer and passionate collector of small-sized samples showing uncommon aesthetical and scientific features.

This note on the first mention of hydrothermal pisolites in Romania is dedicated to the memory of this passionate collector. In the same time this study is meant to motivate also other collectors to provide pristine materials of mineralogical and genetical relevance for Romania, especially related to microcrystals in Baia Mare mining area, where in our opinion, a huge scientific potential is awaiting.

What are ooids and pisolites? Ooids and pisolites are defined as chemical, syndepositional structures, sometimes related to starting detrital grains in suspension, occurring as **mineral aggregates with specific morphology and heterogeneous structure.** They are common in chemically-precipitated sedimentary rocks.

In general ooids and pisolites form by exogenous processes, in continental, lacustrine or marine environments, or rarely in caves, being almost exclusively related to sedimentary rocks. When present in large amounts, ooids and pisolites may give birth to rocks proper, known as oolites and pisolites (pisoliths) respectively.

By definition, **ooids** are spherical or ovoidal concretionary aggregates with sizes between 0.1-2 mm, while **pisolites** are **larger than 2 mm.** In cross section both types of aggregates consist of a **nucleus (core)** represented by quartz or other minerals clasts, bioclasts etc., and an **envelope (cortex)** built-up of successive concentric layers (of variable thickness, in the order of micrometers) of **carbonates** (calcite, aragonite, siderite etc.), **phosphates** (apatite, „collophane"), **silicates** (ferriferous leptochlorites), **oxides and hydroxides** („limonite", hematite) and rarely **Al-hydroxides** or even **halite.**

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Ooids precipitated from agitated warm waters (temperatures around 20°C) supersaturated in Ca carbonate, Fe hydroxides and/or other components mentioned above, in the presence of clasts in suspension which represent the further core for the aggregate.

A large number of ooid-, and less commonly pisolite-containing geological horizons or levels are known in sedimentary successions of various ages from many regions; they were formed in both continental, and aquatic (lacustrine or marine) environments.

In **continental, lateritic** environments ferriferous and bauxitic (consisting of Al-hydroxides) ooids formed, for example in the mined ores from Pădurea Craiului Mts. area.

In **arid continental** areas, **carbonate or even halite ooids** may form at the surface of soils due to ascending diffusion of supersaturated solutions.

In the current **forest soils** in the western part of Romania a distinctive horizon, called „ortstein" is known as being rich in **Fe- and Mn-hydroxides ooids and pisolites** („bobovine").

Calcium carbonate ooids and pisolites are very typical in lacustrine environments, precipitated from **warm, bicarbonate-rich springs.** Well-known occurrences are Karlovy Vary (Czech Republic), or travertine deposits from Romania: Borsec (Harghita county), Banpotoc and Geoagiu Bai (Hunedoara county), that are used as ornamental rocks.

In **marine environments,** levels of **carbonate ooids** are known from Turbuța Formation (Salaj county) of Eocene age etc. Actual and fossil reef assemblages also may contain levels of carbonate pseudo-ooids and ooids.

Other **Eocene marine deposits** rich in **ferriferous ooids** crop out in the neighborhoods of Căpuşu Mic locality (Cluj county) within the *Gryphaea eszterhazy* and *Nummulites perforatus* horizons. This oolitic level was up to 12 m thick and it was exploited as an Fe-containing ore. Laterally the „limonitic" ooids are replaced by **glauconitic ooids,** sometimes forming distinctive levels that may be mined and used as fertilizers (ex. Moigrad, Sălaj county). Similar Fe-rich aggregates have been exploited in France (Lorraine region), mainly consisting of **ferriferous leptochlo rites.** In Romania, such mineral aggregates are known from the Liassic deposits in Banat (Fe-poor) or from the Triassic formations in Pădurea Craiului Mts.. In other countries (SUA – Silurian in age, Russia – west from Ural and Kerci – Neogene) they constitute major, minable sources for Fe.

Marine phosphate ooids are known from Cenomanian deposits in Dobrogea and the Moldavian Platform.

Manganous ooids from Ukraine (Nikopol) and Ciatura, Caucaz, were mined for their rich Mn-content.

Seldom, **siliceous or even pyrite-rich ooids** formed in sedimentary rocks of various ages.

Pisolites are aggregates larger than 2 mm in diameter, showing a similar internal structure as that of ooids (core and envelope). They also form, in general, by chemical precipitation from agitated waters, in the neighbourhood of thermal springs, geysers or even caves.

The **pisolites deposited from thermal springs** from Czech Republic and Romania, as well as **carbonate vadose pisolites** formed in arid environments and **aluminous-bauxitic pisolites** from lateritic soils were already mentioned before.

Siliceous pisolites may be identified around some previous geyser-type thermal springs related to the volcanic chain in the Eastern Carpathians, especially in Gutin and Oas Mts. areas.

A special case is represented by the **glossy carbonate cave pearls** generated either by drops of water dripping from the cave ceiling into small pools in the cave floor, or by chemical precipitation from solutions supersaturated in Ca bicarbonate in pools characterized by continuous movement of the waters. They consist of sand grains in the core and concentric calcite layers as cortex. The shape is almost spherical, the sizes are up to 1-2 cm and the surface is glossy due to the frictions occurring between several pisolites in the agitated waters. Tens of loose, floating cave pearls may form in the same pool (ex. Cocaliere Cave, France). In some caves, polyhedral pearls with rough surfaces were identified, indicating a very feeble water dynamics (ex. Măgura Cave).

Pisolites of magmatic origin

The previous presentation of ooids and pisolites of sedimentary nature was meant to emphasize the many similarities (in shape, typology and genesis) that were noticed with the **hydrothermal pisolites** identified in the vein fillings in Cavnie mine and collected with devotion by Mozes Iosif.

A number of 13 white, porcelaneous and glossy samples were studied. The morphologies were spherical and ovoidal and the diameters varied between 3.5 mm (minimum) and 13 mm (maximum); the detailed size distribution/no, of specimens was as follows: up to 4 mm/4; 5 mm/2; 6 mm/1; 7 mm/1; 9 mm/2; 10 mm/2, and 13 mm/1, *i.e.* a total of 13 specimens. Five of these samples were broken artificially for allowing the investigation of the core and the thickness of the concentric carbonate layers.

Morphology of hydrothermal pisolites

All the studied pisolites, no matter of their size, showed **glossy-porcelaneous surface** (after etching with HC the surface became opaque). In spite of their general ovoidal-spherical, slightly elongated shape, the pisolites' surface may show irregularities (pits and bumps) generally reflecting the shape of the core, *i.e.* of the mineral or association of minerals consisting the broken fragment of a hydrothermal vein. In other words, the **external morphology is directly related to the more or less regular shape of the core. If the cortex is thinner and slightly translucent,** it allows the darker core to be noticed; this feature indicates that the cortex was formed preferentially, probably the process being more extended in the upper part of the pisolite, while the lower part was floating in the relatively long-term still water (Photo 1).

The core of the pisolites mainly consists of irregular clasts represented by either a single mineral species (ex. **galena,** Photo 1i, 1), or by a mineral assemblage consisting of sulfides such as: **sphalerite** (both marmatite and cleiophane varieties), **pyrite** and

chalcopyrite (Photo lb, f). Only in a single broken pisolite we have noticed a core consisting of an elongated **calcite** clast containing small grains of sphalerite (Photo Id.) The size of the core varies from 9 to 1.5 mm, being the factor that finally controls the total diameter and the shape of the pisolite.

The envelope (cortex) of the pisolites is usually glossy and consists of white micrometer-thick layers of carbonates, probably in mixtures with white clay minerals (kaolinite?). The average thickness of the cortex is 1-1.5 mm, but occasionally it can reach 2 mm in the areas where the mineral core showed pits; in the cases mentioned above, when the core is slightly visible beneath the translucent, almost transparent crust, probably the thickness is below 1 millimetre (Photo la, e, b, d, g, i, and 1).

Genetic considerations. Taking into account the pisolites' morphology and composition, we assume a genetic model that is similar to that for the sedimentary pisolites, but characterized by some peculiarities; the closest resemblance is that with the glossy cave pearls.

We assume the following genetic conditions in the environment of formation:

– the irregular clasts consisting of hydrothermal minerals that as a rule build-up the core of the pisolites point to a sulfide vein system that, subsequent to its formation, was locally affected by tectonics and fragmented. Fresh, sub-centimetre mineral debris resulted, that accumulated in voids (geodes, pools) partly filled with fluids.

– supplies of high-pressure bicarbonate-rich solutions entered the geodes laterally, thus the small ore fragments were under continuous move in the lower parts. Progressively and during large time intervals, thin, micron-sized layers of carbonates were precipitating around the clasts. Periodically the bicarbonate solutions left the geodes through lateral channels located at almost the same height as the supply channel, leading to the permanent agitation of the nascent pisolites within the fluids and preventing their adhesion to the floor or the walls of the void.

–the continuous movement of the bicarbonate-rich fluids, thus of the currently-forming pisolites was also facilitated by the access of a mofette-type CO_2 gas at the bottom of the void. This also contributed to the friction between the neighbouring pisolites, thus to the glossy appearance of their surface („pearl-like"). The final lustre was also influenced by the chemical action of the weak carbonic acids formed in solution, that lead to the precipitation of thin carbonate pellicles at the surface.

– thus, in time, all the ore fragments floating in the small pools at the basis of the voids were progressively surrounded by a carbonate envelope; as a result a small deposit of **hydrothermal pearls (pisolites)** was generated. When the fluids' (including gases) supply ceased, the pisolites were deposited in the basal part of the voids and remained loose.

According to our best knowledge, this is the first mention on hydrothermally-related pisolites in Romania (or even worldwide?), probably generated in connection with the post-volcanic mofette-type activity in the Cavnic mining area. The appearance of the magmatic pisolites proves the general pattern for ooids' and pisolites' formation in both sedimentary and magmatic environments. The latter, however, show some specific particularities.

We would like to mention that not far from Cavnic, in the old andesite quarry from Şurdeşti, on the slopes of Cavnic valley, some sub-millimetre **siliceous ooids** in the **assemblage of Trestia chalcedony with asphaltite** (Ghiurcî et al., 2002); the ooids cover asphaltite are were generated by late hydrothermal processes. Both these types of hydrothermal pisolites are **mineralogical rarities** and constitute valuable **museum samples.**

Pisolitic tuffs are mentioned in the literature (Anastasiu, 1978) as a result of the cementation of either volcanic mud spheres, or of fine wet concretionary ashes; we have noticed such deposits within the spongy-vacuolar tuff from Văleni-Coaş, in the Neogene deposits of the Baia Mare Basin.

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Studii şi cercetări, Geologie-Geografie 10, 2005, Bistriţa, p. 53-63

ZEOLITIC VOLCANIC TUFFS FROM ŞOIMENI (CLUJ COUNTY), RAW MATERIALS USED FOR NH_4^+ REMOVAL

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Abstract: The study concerned the volcanic tuffs cropping out in Şoimeni area (Cluj county), that belongs to the pyroclastic outcrops of Dej Tuff Level of Badenian age. The zeolitic volcanic tuffs from Şoimeni (Cluj county) are mainly represented by rhyodacitic vitric and vitric-crystal (upper, microporous fine-grained level), and lithic-crystal and lithic-vitric (the lower and medium levels, coarse- and medium-grained granular) tuffs. The mineral assemblage suggests a rhyo-dacitic petrographic type of the volcanic tuff from Şoimeni. The main zeolite species identified in volcanic tuffs from Şoimeni is clinoptilolite. Quatitatively, zeolites reached between 5-25% (in the macroporous level-sample S1) and 35-80% (in the micro porous level-sample S2) of the rock mass. Both samples were subjected of chemical treatment with HCl and NaCl, followed by the ionic exchange process. Synthetic solutions containing NH_4^+ ions were used. For both samples, ionic exchange efficiencies higher then 90% were reached. In case of S2 sample ammonim ions were removed completely.
Key words: Şoimeni, natural zeolite, clinoptilolite, wastewaters, ammonium, ionic exchange

Introduction

Zeolite group is included in the tectosilicates sub-class, and it refers to hydrated aluminosilicates with alkali and alkaline earth cations building up an infinite tridimensional crystalline network. The main consequence of this structure type is represented by the reversibility of the hydration and cation exchange processes that preserve the original network. Thus, zeolites may be used as ionic or molecular filters, because they are characterised by larger sizes than those of the ions (molecules) that pass through.

Zeolites may form in magmatic, metamorphic and sedimentary rocks. In the sedimentary deposits, five species are present more frequently: analcime, ***clinoptilolite,*** heulandite, laumontite and phillipsite. In this geological frame zeolites are formed as alteration and neoformation products in marine or lacustrine submersed environments (pH ~ 9), due to the transformation of magmatic products such as volcanic glass and primary aluminosilicate minerals.

The sedimentary zeolitic rocks from Romania are represented by Tertiary volcanic tuffs dominated by the presence of **clinoptilolite.** This zeolite species represents between 30 and 90% of the rock mass. Clinoptilolite is characterised by a lamellar-prismatic habit and

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the chemical composition given by the formula:

$$(Na_2O)_{0,7}\ (CaO)_{0,10}\ (K_2O)_{0,15}\ (M_gO)_{0,05}\ [Al_2O_3\ .(SiO_2)_{8,5\cdot 10,5}]\ 6\text{-}7H_2O$$

NH_4^+ and NH_3, forms of inorganic nitrogen, are some of the most common water pollutants. Ammonium is usually present in untreated sewage, industrial wastewater disch Argeş (quench waters at coking plants, gasworks sites), and landfill leachates (fertiliser use, contaminated land) in concentrations ranging from 1 to 7000 mg/dm^3 (Buss et al., 2004). Due to the fact that in certain conditions it is a relatively mobile contaminant and considering the wide domain of concentrations, ammonium is considered a key contaminant in risk assessment. In drinking water treatment, for example, NH_4^+ can reduce disinfection efficiency, lead to nitrite formation, and cause taste and odour problems (Buss et al., 2004).

In sewage treatment units, ammonium ions are first transformed during the nitrification process (biological oxidation), followed by the denitrification process. When NH_4^+ concentration is too high, alternative methods for removal are considered. Ionic exchange process on synthetic (Dowex 50wx8, Purolite MN500) (Jorgensen, Weatherley, 2003) and natural exchangers – *mineral deposits from Mexico (Levya-Ramos et al, 2004), Chilean zeolite (Englert and Rubio, 2005), Turkish zeolite (Sarioglu, 2005), New Zeeland clinoptilolite and mordenite (Weatherley and N.D. Miladinovic, 2004), Croatian zeolite (Farkas et al, 2005), Permeable reactive barriers containing clinoptilolite (Park et al, 2002), Italian clinoptilolite (Langella et al. 2000)* – was widely studied. Baykal and Guven (1998) and Baykal (1998) proposed the ionic exchange using clinoptilolite for the removal of peak concentrations of ammonia from domestic wastewater as a second stage, by itself or in combination with sand filters or burned clay. They found that all combinations studied are successful in the removal of peak concentrations of ammonia, and hence can be used as a polishing unit (Baykal and Guven, 1998; Baykal, 1998).

In order to test the domestic similar natural materials, our study concerned the volcanic tuffs cropping out in Şoimeni area (Cluj county). Samples of zeolitic volcanic tuffs from natural outcrops from Şintăului Hill (profiles of 50 m heights) (Pl. I, fig. 1) were collected for laboratory tests.

Geology of the region

The occurrence of volcanic tuff from Şoimeni area (Cluj county) belongs to the pyroclastic outcrops of Dej Tuff Level in the Transylvanian Depression.

The pyroclastic rocks are underlying detrital rocks (slightly consolidated sandstones, conglomerates, sands and thin marly interlayers) belonging to the Hida Formation, of Ottnangian age. The Badenian deposits (which include the zeolitic tuffs deposits) have a transgressive character and they show the largest extension in the Transylvanian Basin (Mârza et al, 1991). The intrabasinal volcanism that started with the formation of the „Dej Tuff' took place along peri- and intrabasinal crustal fractures (Mârza & Meszáros, 1991).

The „Dej Formation" is of Lower Badenian age and consists of volcanic tuffs and marly interlayers, and it marks the beginning of the Neogene volcanic activity (Styrian phase).

Raw/bulk rock samples were collected from the lower level-psefitic-psamitic macroporous tuff (sample S1) and the median level-pelitic-psamitic microporous tuff (sample S2) of the volcanic tuff cropping out in Şintăului Hill. Several specific investigations, such as: optical microscopy, bulk chemical analyses, X-ray diffraction (DRON-3 Ka tool unit with a Cu anticathode) were carried out for the characterisation of the properties of the volcanic tuffs.

Results

In the studied profiles from Şintăului Hill the basal deposits are represented by the detrital units of the Hida Formation, which are overlaid by polygenous and tuffaceous conglomerates respectively. On their top, a spongy tuff level followed by an interlayering of tuffs and conglomerates develop.

The cineritic sequence has normal graded bedding (rhythmic interlayering of coarse and fine tuffs).

The coarse horizons contain lithoclastic fragments consisting of cineritic material of rhyolitic type deposited right after the volcanic explosion, or of fragments from the infrastructure of the volcanic structure. These horizons show vacuolar-scoriaceous textures (Pl. I, fig. 2).

The matrix of the lithic fragments is represented by devitrified volcanic glass, while the pores (voids) are filled with zeolites of diagenetic origin (5-25% of the rock mass).

In the upper part of the sequence, the pelitic-psamitic horizons are mainly intraclastic and they correspond to the final stage of volcanic ash deposition. At the contact with seawater, halmyrolitic processes lead to volcanic glass devitrification and neoformation of zeolitic and smectitic minerals. (Bedelean & Stoici, 1984).

The volcanic tuff from the fine-grained horizons (S2 sample) consist of volcanic glass (between 70-85%), crystalloclasts, (between 15-25%), and lithoclasts in subordinate amounts (2-3%).

The main component is represented by transparent and isotropic *volcanic glass* as fragments with angular endings. Frequently, the glass fragments show fissures and Y-shaped inclusions or separations caused either by a rapid cooling, or by the presence of gas bubbles. Under magnifications of x 500-600 an advanced degree of devitrification is noticeable, the glass being significantly replaced by zeolites – mainly represented by clinoptilolite. These zeolites are present as micron- and submicron-sized crystals replacing the glass matrix (Pl. II, fig. 3), or as larger crystals in the pores resulted by gas removal or voids resulted from the levigation of the primary mineral components (Pl. II, fig. 3, 4).

The crystaloclasts are represented by (Pl. II, fig. 1, 2):

– xenormorphous quartz – angular fissured and fragmented grains, magmatica-lly-corroded and showing normal extinction, of magmatic origin;

– feldspars: both K-feldspats (rarely microcline) and acid plagioclases;

– idiomorphous biotite and muscovite;

– green hornblende;

–the secondary minerals are mainly represented by zeolites, among which *clinoptilolite* dominates. This is a general statement for all the tuff occurrences in Cluj county, for the cases when the devitrification of volcanic glass reached an advanced stage. Zeolites replace the volcanic glass in amounts ranging between 35-80% of the rock mass, depending on the structural-textural characteristics and primary composition of the piroclastic rock.

– other secondary minerals are represented by Fe oxy-hydroxides, chalcedony;

– accessory minerals: apatite, zircon, opaque minerals.

The mineral assemblage suggests a rhyo-dacitic petrographic type or the volcanic tuff from Şoimeni.

Lithoclasts are represented by sedimentary (sandstones), magmatic and metamorphic rock fragments (and additionally fragments of carbonate fossils).

Based on their structural-textural properties (the ratio between glass, crystals and lithic fragments), and the mineralogical composition identified under the optical microscope, the studied volcanic tuffs from Şoimeni area – Şintăului Hill (Cluj county) can be defined as vitric and vitric-crystal (upper, microporous fine-grained level) (Pl.II, fig.1, 2), and as lithic-crystal and lithic-vitric (the lower and medium levels, coarse- and medium-grained granular) tuffs respectively (according to Anastasiu, 1977).

Genetically, the deposits are fallout tuffs. The subaerial and explosive nature of the processs is proved by angular and concave-convex shape of the volcanic glass fragments.

The ***bulk chemistry*** indicates general rhyolitic, rhyodacitic compositions of the zeolitic volcanic tuff from Şoimeni.

Chemical composition of the volcanic tuff from Şoimeni – Cluj county
(analysis performed at ICPMSN Cluj-Napoca, 1975-1978)

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	TiO_2	PC
67.24	10.40	1.06	3.31	0.70	5.00	2.00	0.34	8.96

X-ray diffraction (both qualitative and quantitative evaluation, including the estimation of the zeolites content in the tuff samples) was performed on raw tuff samples (S2). The main zeolite species identified was *clinoptilolite.* It is characterized by the following d values (Ĺ): 8.99, 7.87, 6.79, 5.20-5.26, 5.08-5.11, 4.65, 3.95, 3.92, 3.41, 3.17,2.97,2.72-2.78.

Discussion

The zeolitic volcanic tuffs from Şoimeni (Cluj county) are mainly represented by rhyodacitic vitric and vitric-crystal (upper, microporous fine-grained level), and lithic-crystal and lithic-vitric (the lower and medium levels, coarse- and medium-grained granular) tuffs.

Zeolites formed as a result of the reaction between marine water and solid matter, especially represented by volcanic glass. The marine genetic conditions indicate pH values between 7 and 8 and salinity values close to the normal marine ones. The neoformed zeolitic species were dependent on temperature, pressure and the variable chemical parameters: Si: Al ratio, Ca^{2+}, Na^{+} and K^{+} ratios and the pressure-dependent H_2O (P_{H_2O}) and CO_2 (P_{CO_2}) activities (Bedelean & Stoici, 1984).

The amount of zeolites is directly correlated to the original amount of volcanic glass. Thus, the zeolite-richest levels are represented by the vitric tuffs, and respectively medium- and fine-grained vitric-crystal ones.

The poly-sequential character of the pyroclastic formation, as well as the presence of hot flows pleads for a local volcanic source, similar to the situation of other structures in the region.

Zeolite formation took place both in the mass of vitroclasts as well as in the voids between them:

– Zeolitization of vitroclasts represents a reorganisation of the glass (devitrification), thus poorly crystallised clinoptilolite forms; crystallites often show skeletal features, with frequent dislocations and sub-micron sizes. The aqueous environment plays an important role during this process due to the high ionic concentrations (seawater), which favour the exchange reactions.

In a first stage, isolated crystallites occur in the glassy matrix; in a more advanced stage of zeolitization, the number of crystallites increases, they form lace-like and spongy aggregates and glass is almost completely replaced. Clinoptilolite in sedimentary rocks generally occur as euhedral plates and laths, 1-2 microns thick and several microns in lenght (Mumpton amd Ormsby, 1976).

Clinoptilolite formed in the void spaces between/or inside the vitroclasts shows idiomorphous crystals. The voids where idiomorphous clinoptilolite developed look like microgeodes. This type of clinoptilolite crystallises directly from the Al and Si- rich solutions resulted from the partial solubilization of glass, more or less filling the empty spaces. Concentration gradients occurring at the limits between crystals and solution determined the migration of the ions resulted from the glass dissolution towards the voids where the concentration of the solution was low.

Experimental

Adsorptive and ionic exchange properties of natural zeolites are determined by the structure of their crystalline network, which determine the channel system and also by the negative charge excess due to $[AlO_4]^{5-}$ tetrahedrons compensated by mono- or divalent cations (e.g. Na^{+}, K^{+}, Ca^{2+}, Mg^{2+}). These counter ions are mobile and can be totally or partially exchanged during ionic exchange processes.

NH_4^{+}removal was realised on two samples, granulation 0.2-0.4 mm, of natural zeolites from Şoimeni area. Each sample was chemically modified with HCl 1M (Z-H form) and NaCl + NaOH 1M pH = 10 (Z-Na form).

The stages involved in the zeolite preparation are as follows: crushing, grinding, size separation, washing with distilled water, drying at 105°C for 6 hours, treatment with HCl 1M in a stirring reactor with a zeolite acid solution ratio of 1: 10, washing with distilled water to pH = 7 and finally drying at 105°C for 6 hours. At the end of this sequence we obtained the zeolite in -H form (Z-H). Also, during the treatment with HCl, zeolite channels are cleaned and pores opened. To bring the zeolite in -Na form which proved to be more efficient in the ionic exchange process,[12-14] the zeolite is subjected subsequently to an alkaline treatment with strong Na^+ solution (NaCl 1M solution brought to pH =10 with a NaOH 1M solution) according to equation (1). After the alkaline treatment the zeolite samples are washed again with distilled water to pH = 7 and dried for 6 hours at 105°C.

$$\text{Z-H} + \text{NaCl} \rightleftarrows \text{Z-Na} + \text{HCl} \qquad (1)$$

For the ionic exchange study we used a synthetic solution containing NH_4^+ ions (0.07g/dm^3) prepared from ammonium chloride (analytical purity reagent). Determination of ammonium ions in solution was realised using a Jenway spectrophotometer (Nestler solution, 420 nm). Experiments were carried out without any modification of temperature and pH for the synthetic solutions.

The ionic exchange process were realised in a batch reactor in static regime using 10 g zeolite and 100 ml ammonium ions solution (zeolite:solution = 1: 10). Samples were taken every 24 hour until the equilibrium was reached. We also worked on a fixed bed column (d_i = 15 mm) containing 5 g zeolite, with a flow rate of 0,055 ml/s (for all experiments) when samples were collected every 50 ml until the zeolite was exhausted (dynamic regime). The experiments were realised at room temperature. The ionic exchange reaction, which takes place in our system, is:

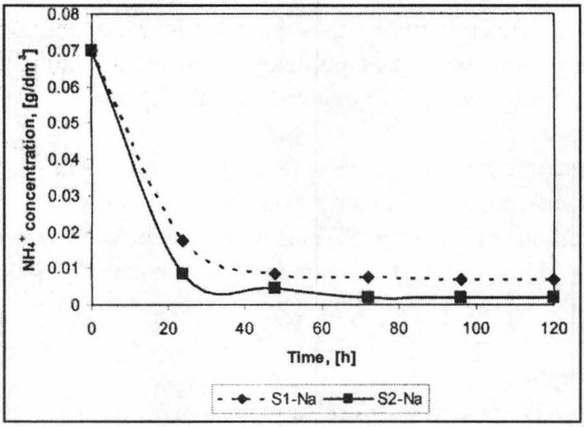
$$\text{Z-Na} + NH_4^+ \rightleftarrows \text{Z-}NH_4 + Na^+ \qquad (2)$$

The results obtained for the two samples considered are presented for static and dynamic regimes, respectively.

a. Comparison between the efficiency of the zeolite samples in static regime.

Variation of ammonium ions concentration in time for both samples (S1-Na and S2-Na) is presented in figure 1. The ionic exchange reactions took place for both samples considered (ammonium concentration in water decreased); therefore the zeolites under study are considered to be active in the ionic exchange process. In case of S1-Na sample, the efficiency of ionic exchange was 90.36%, while for the S2-Na sample the efficiency increased to 97.48%. The equilibrium, in both cases, was reached after 48 hours.

Figure 1. Comparison between variations of NH_4^+ concentration in time for the two zeolite samples in –Na form and static regime.



b. Comparison between the efficiency of the zeolite samples in dynamic regime.

In this part of the work we studied the ionic exchange process in dynamic regime, in a fixed bed column, for S1-Na and S2-Na samples. Results are presented in figure 2. The efficiency of the ionic exchange process was calculated to be 93.02% for S1-Na sample and 100% for S2-Na sample, which confirms the results obtained in static regime. Also, the wastewater volume that can be processed, before the zeolite exhaustion, increased from approximately 800 ml for S1-Na sample to more than 1300 ml for the S2-Na. Therefore S2-Na sample presents a higher exchange capacity and is more appropriate to be used in a wastewater treatment process. S2-Na sample properties can be correlated with the clinoptilolite content, which is higher compared with S1-Na sample.

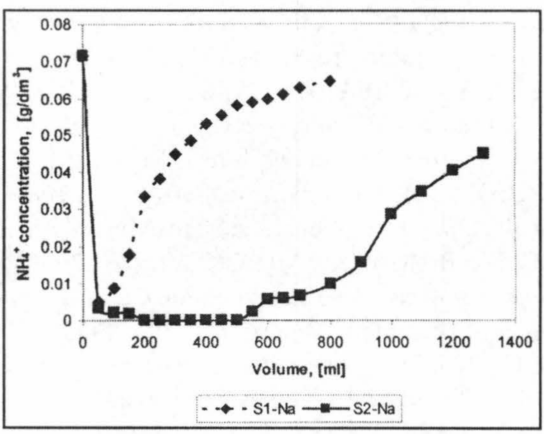


Figure 2. Comparison between variations of NH_4^+ concentration with treated wastewater volume for S1-Na and S2-Na samples in dynamic regime.

Conclusions

(1) The zeolite samples considered can be used in wastewaters treatment to remove ammonium ions.

(2) The most efficient sample is S2-Na, in static and dynamic regime as well.

(3) The ammonium ions were completely removed after 200 ml wastewater passed on S2-Na sample, while the zeolite exhaustion takes place after more than 1300 ml wastewaters are processed.

(4) After the ionic exchange process takes place, the zeolite samples in Z-NH_4 form can be regenerated and reused in the same process.

(5) Ionic exchange process on S2-Na sample can be used as a finishing stage (after the biological process) in wastewater treatment plants in order to assure compliance with environmental standards (see references).

Acknowledgment

This material is based upon work supported by CNCSIS Grant 1745.

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*** Lege 458/8.07.2002 privind calitatea apei potabile.

*** Hotărâre 188/28.02.2002 pentru aprobarea unor norme privind condiţiile de descărcare în mediul acvatic a apelor uzate.

*** Hotărâre 352/21.04.2005 privind modificarea şi completarea Hotărârii 188/28.02.2002 pentru aprobarea unor norme privind condiţiile de descărcare în mediul acvatic a apelor uzate.

*** Lege 311/28.06.2004 pentru modificarea şi completarea Legii 458/8.07.2002 privind calitatea apei potabile.

Plate I

Fig. 1.
Natural outcrop of the vulcanic tuff. Şintăului Hill, Şoimeni (Cluj)

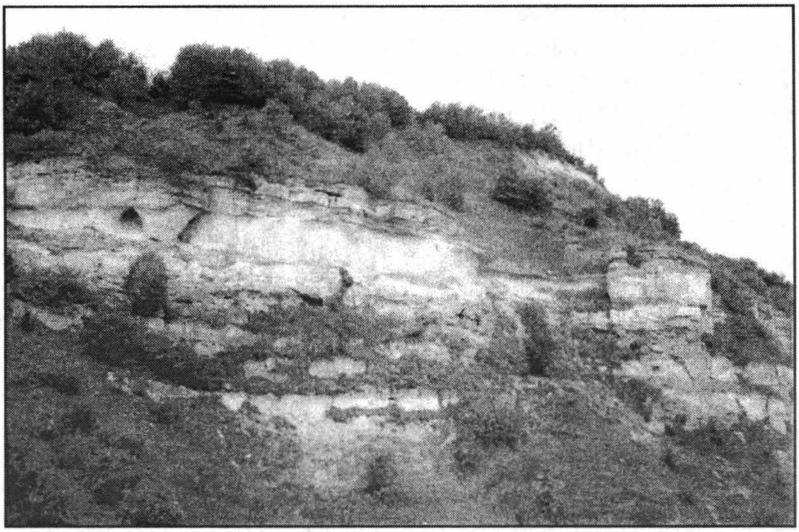

Fig. 2.
The coarse horizons (lower level-psefito-psamitic, macroporous tuff) contain lithoclastic fragments consisting of cineritic material of rhyolitic type, or of fragments from the infrastructure of the volcanic structure; the matrix of the lithic fragments is represented by devitrified volcanic glass Şintăului Hill, Şoimeni (Cluj county)

Plate II

Fig. 1.
Vitric-crystal tuff from Şintăului Hill, Şoimeni (Cluj county), sample S2, N+

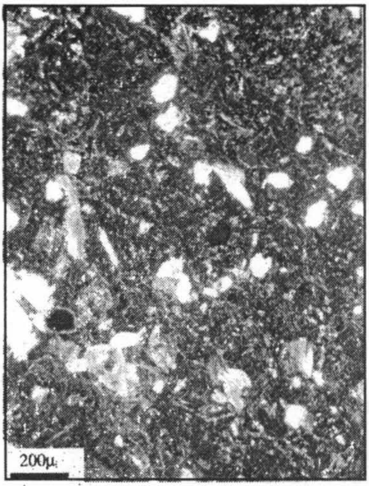

Fig. 2.
Vitric-crystal tuff from Şintăului Hill, Şoimeni (Cluj county), sample S2, N+

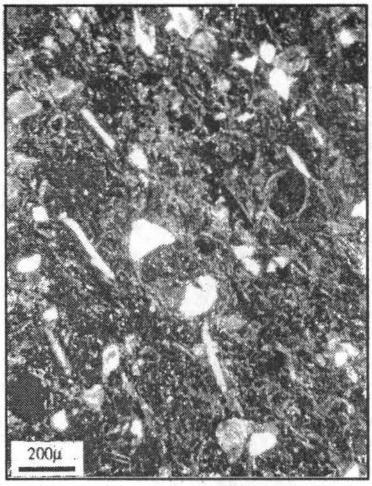

Fig. 3.
Zeolites (clinoptilolite) developed as larger crystals in pores or replacing the glass matrix. Sample S2, median level, pelitic-psamitic microporous tuff. Şintăului Hill, Şoimeni (Cluj county), 1N, 400X

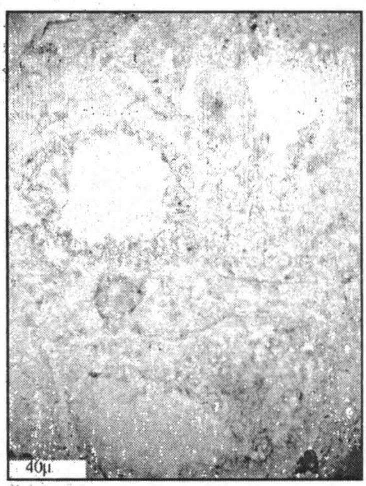

Fig. 4.
Zeolites (clinoptilolite) developed as larger crystals in pores. Sample S2, upper level, pelitic-psamitic microporous tuff. Şintăului Hill, Şoimeni (Cluj county), 1N, 400X

Studii şi cercetări, Geologie-Geografie 10, 2005, Bistriţa, p. 65-72

CINERITIC CONCRETIONS IN THE VOLCANIC TUFF FROM VALEA STEJARULUI (MARAMUREŞ)

Ioan CHINTĂUAN*

Abstract. *Cineritic concretions in the volcanic tuff from Valea Stejarului* (MM). Cineretic concretion formed by cementation of the fine grains consisting the tuff, after its submerse sedimentation from volcanic ash, around nuclei represented by carbonized vegetal remains included into a fine pelitic matix, in its turn originally surrounded by a pellicle of grains bonded by Fe and Mn oxy-hydroxides that subsequently transformed into a crust. The cineritic concretions from Vadu Izei – Valea Stejarului were formed within Badenian volcanic tuffs.
Key-words: Cineritic concretions, Badenian volcanic tuffs

Based on a long-term study and evaluation of concretions, especially of sandstone ones, located in various geological formations of Romania and abroad (Chintăuan, 2002; Chintăuan, 2003), several compositional, structural, textural, morphological types were defined by the author. By using these criteria, sandstone concretions of various geological ages and regional distributions could be compared.

Among the concretion categories and types mentioned in the references, as well as those defined by the author (Chintăuan & Codrea, 2000) no mention refers to concretions consisting of, and located within volcanic tuffs.

Such concretions, defined by us as „cineritic concretions" were identified hosted by the deposits of volcanic tuffs outcropping on the left side of Stejarului Valley, upstream from Vadu Izei and the confluence of the above-mentioned valley with Iza Valley; upstream from Valea Stejarului locality (Maramureş county).

According to Ghiurcă (2005, personal communication), concretions may form within cineritic beds or mixed cineritic-sedimentary deposits (tuffites), as confirmed by his own observations regarding the tuffites from Curtuiuşului Valley, „where concretions occur in various shapes and sizes between 5-15 cm, usually displaying marine fossils – crabs or mollusks – in their centre".

Anastasiu (1978) mentioned the presence of „pisolitic tuffs" formed by the consolidation of either spheres of volcanic mud, or of fine concretionary, wet volcanic ash. Ghiurcă (2005, personal communication) noticed similar tuffs at Văleni – Coaş (Baia Mare, Neogene basin) having a spongy-vacuolar fabric.

However, the cineritic concretion have a different origin: they formed by cementation of the fine grains consisting the tuff, after its submerse sedimentation from volcanic ash, around nuclei represented by carbonized vegetal remains included into a fine pelitic matrix, in its turn originally surrounded by a pellicle of grains bonded by Fe and Mn oxy-hydroxides that subsequently transformed into a crust.

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The ooids and pisolites represent globular (pseudo-spherical) agglomerates consisting of a particular mineral, or of concretionary aggregates (concretionary structures) of sand particles (lithoclasts; aleuritic aggregates).

There is a significant difference between the chemical processes that lead to the formation of mineral aggregates (of various natures) and those related to sandstone, or cineritic concretions.

Most of the concretions of the first type are syndepositional, while the sandstone and cineritic concretions are post-depositional.

The accretion process in marine sands and submerse cinerites takes place after the sediment deposition and burial by younger sediments; subsequently, the whole sedimentary succession was emerged and the lithification process started. During the transition of sediments to sedimentary rocks and afterwards, diagenetic changes affected the deposits. Sediment genesis was followed by lithification or diagenesis.

Physical, chemical, and biochemical post-depositional processes take place during compaction, dissolution, cementation, neomorphism (recrystallization, polymorphous transformations, crystal growth), metasomatism and diagenetic differentiation stages.

During diagenesis, the formation of sandstone and cineritic concretions may proceed, under specific environmental conditions. In the first part of the process, the volcanic ash is sedimented at the bottom of the aquatic basin; subsequently, the pH and Eh values vary significantly under the effect of organic matter. At the beginning of the process the environment is oxidizing (Eh > 0), the pH values are around 6,5-7 and CO_2 is present. Under these circumstances, neoformation products were generated and the organic matter was decomposed, all these processes taking part within the sediments, at depth no grater than 50 cm below the water/sediment interface. Processes of mineral oxidation and dissolution are registered at the surface of the cinerites.

A later stage, of „early burial" follows, characterized by an reducing, anaerobic environment with Eh = 0,4-0,6, pH = 7-8 and restrictive water circulation pattern (Rădulescu & Anastasiu, 1979, p. 229). The changes are controlled by interstitial waters and H_2S.

According to Rădulescu & Anastasiu (1979), the two stages represent the „syndiagenesis", *i.e.* the first stage of diagenesis, for which neoformed minerals such as siderite, calcite, sulfides, or pyrite and marcasite concretions are typical products.

The same authors separate a second stage, „anadiagenesis", which includes the physical-chemical processes taking place in the submerse sediments during their progressive burial, and is located between 100 m (lower limit for the syndiagenesis) and 10.000 m (upper limit for metamorphic processes). Such transformations lead to lithification.

The progressive accumulation or deposition of sediments causes a reductive environment by fluid removal and concentration of salts from the remnant solutions. The pH values are higher (8-9) and thus the environment is more alkaline.

Chintăuan & Codrea (2000), according to Rădulescu & Anastasiu (1979) who cited Krumbein & Strahov, listed three types of processes during anadiagenesis:

– physical changes due to compaction and recrystallization;

– redistribution of the material by dissolution, cementation and removal of the cement;

– formation of new minerals by reactions between the ions present in the interstitial waters and the solid particles from the sediments.

The progressive burial leads to a shortening of the distances between the particles, thus more favorable conditions for inter-particle chemical reactions by enhanced diffuse ionic exchanges and dissolution processes. The fine sediments, such as volcanic ash, are much easier submitted to lithification (including *via* recrystallization), thus forming the volcanic tuff, as compared to coarser ones (including sand). Cineritic concretions formed within fine volcanic ash deposits which, originally as sediments and then as rocks proper, embedded vegetal rests; the carbonized vegetal fragments were surrounded by fine cineritic material and constituted the nuclei – concretionary centers.

A relatively great permeability of the cinerite, overlaid by other sediments, permitted the interstitial waters to circulate, providing dissolution and cementation processes that finally led to the formation of cineritic concretions. The cement within the cinerite particles consists of silica and sulfates; its formation continued also after the formation of the volcanic tuff and its emersion.

From this point on, the evolution took place subaerially, even if the host-rock of the concretions was still covered by a thick pile (up to 3,000 m thick) of sediments.

This stage, the „epigenesis", is characterized by concretionary processes under descending meteoric water circulation with low pH values.

The epigenetic processes cause the redistribution of the components of the sedimentary rocks under the almost exclusive influence of the percolating waters; they consist of dissolution, precipitation, recrystallization, mineral neoformation (under slightly oxidant – Fe and Mn hydroxides, or slightly reducing – carbonate conditions) processes. Concerning the sandstone and cineritic concretions, this stage lead to the formation of the Fe and Mn hydroxides crust around the pelite containing the carbonized vegetal rests.

In many cases, sandstone and cineritic concretions cross-cut the stratification planes, or they consist of rocks originating from different beds; such arguments clearly point out that the genesis of the concretions was subsequent to the rocks consolidation.

The presence of concretions in gritty or in compact sandstones, as well as within volcanic tuff levels is a clear evidence that concretionary processes may take place also in sedimentary rocks with a relatively homogenous grain size distribution. Concretion formation may take place in any of these rock types, but definitely only under specific pH, Eh, CO_2, H_2S, lithostatic pressure, hydrostatic etc. conditions. If the sediment contained vegetal rests, or if the deposition of some vegetal rests was overlapping the sedimentation, the first condition for concretionary processes to take place is fulfilled, *i.e.* the nucleus – concretionary centre is provided.

Vegetal rests are common in sands when they are deposited in quiet areas, in the proximity of the shore, of aquatic basins.

Sandstone concretions are typical features in compact sands or in gritty sandstones of various ages (in Romania in the Paleocene – Pliocene interval), but most of them occur in compact Sarmatian sands; in Romania, the Sarmatian deposits are the richest ones in sandstone concretions.

The cineritic concretions from Vadul Izei – Valea Stejarului were formed within Badenian volcanic tuffs, about 30 m thick, fissured and brecciated by the magmatic intrusive bodies that pierced the sedimentary rocks, including the tuffs, in a marginal position. The concretions consist of the same material as the tuff, but, at the concretions' level, the cement/

matrix of the fine volcanic ash particles slightly differs from that in the rest of the tuff deposit.

In the steep ravines from Cisoi resulted from the local surface mining activities, two almost vertical, thick and compact tuff levels pierce the thinner, more friable layers along faults and give birth to an arch-like structure; these features are the results of the intrusion of the magmatic body in the neighborhood. In fact, the whole succession of sedimentary rocks dominated by the volcanic tuff from Petriceaua Hill, including the outcrop from Cisoi, is pierced by effusive bodies. The cineritic concretions are located only in the basal compact tuff, on the right (downstream) from the fault along which the tuff layers were uplifted (or downlifted) and reached the vertical current position.

The presence of such concretions in these deposits indicates that cineritic concretions may form only within cinerites deposited into marginal, quiet areas of aquatic basins, even if the basins have great spatial extensions.

The large areas covered by „the Dej tuff" („Dej Formation") and its thickness (50-90 m) indicate the existence of a wide aquatic basin during the Lower Badenian with extensions reaching Maramureş area. A gulf of this basin, with deep but quiet waters, was located in the northern end, at Vadu Izei.

The lack of cineritic concretions in the other marginal areas may be related to the local tectonic instability, while in the central parts of the basin the vegetal rests that provided the nuclei – concretionary centers, were lacking.

It is possible that such cineritic concretions to be identified also in other sectors of the marginal areas, more probably in the south-eastern areas of occurrence of the „Dej Formation".

Fig. 1.
The outcrop of volcanic tuff with cineritic concretions from Cisoi – Petriceaua Hill.

Fig. 2.
Petriceaua Hill and the outcrop of volcanic tuff in the left side of Stejarului Valley

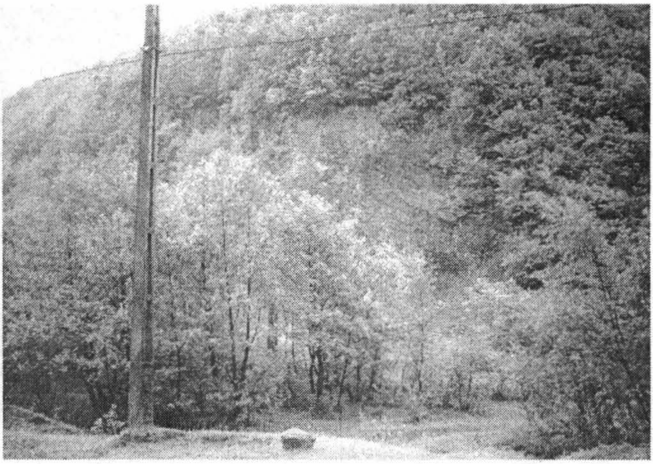


Fig. 3.
Vertical beds of volcanic tuff along the fault (F)

Fig. 4.
Cineritic concretions within the compact tuff level

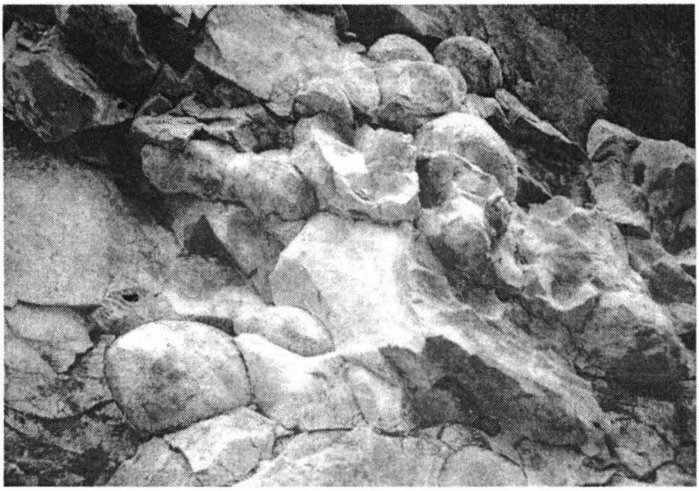


Fig. 5.
Cineritic concretions within the tuff

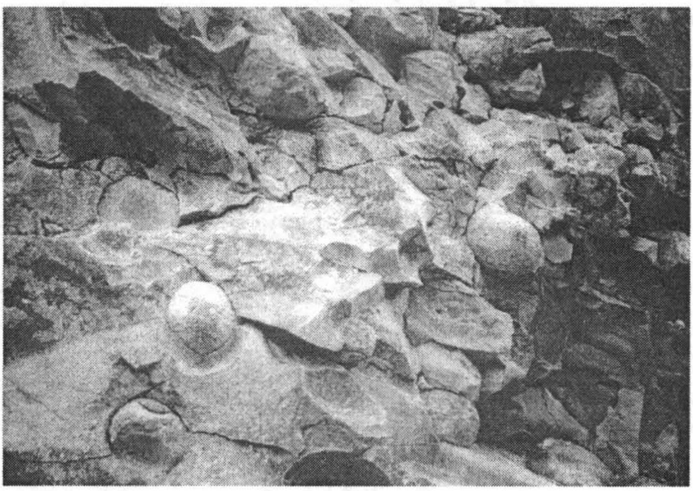


Fig. 6.
„Nests" of cineritic concretions within the volcanic tuff

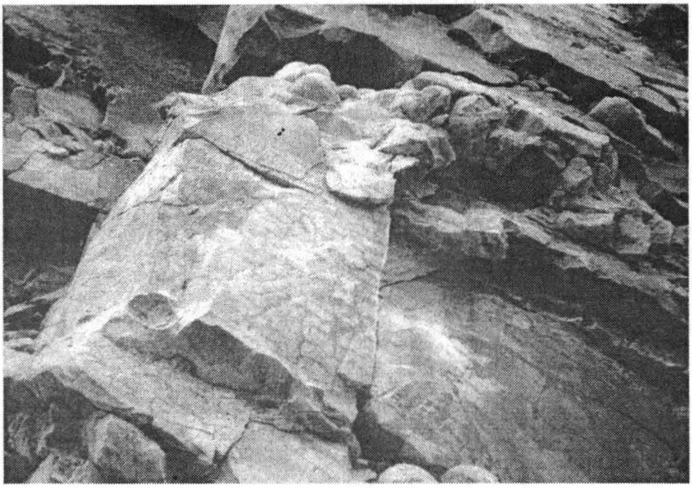


Fig. 7.
Alignments of cineritic concretions within the tuff

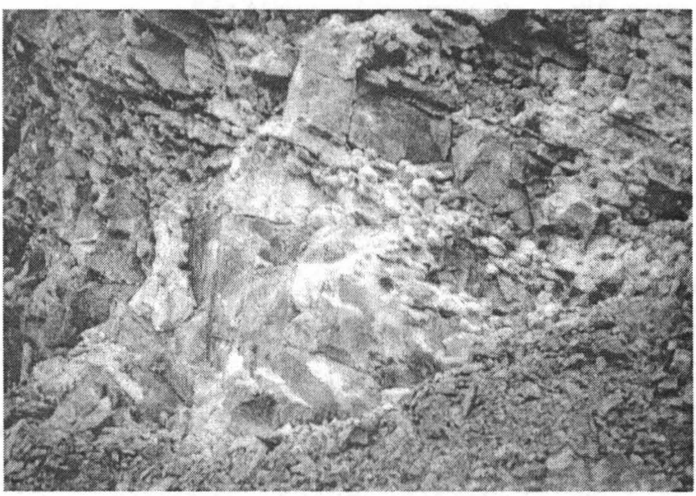
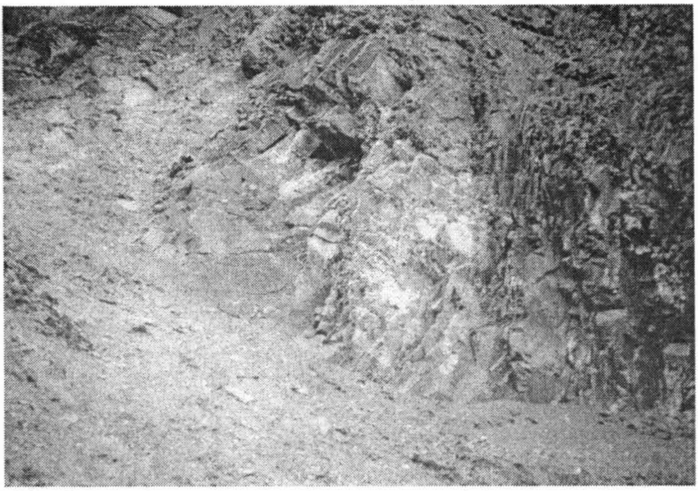


Fig. 8.
Vertical beds of tuff cropping out at Cisoi



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GEOLOGY, GEOARCHAEOLOGY

Studii şi cercetări, Geologie-Geografie 10, 2005, Bistriţa, p. 75-78

PAN USED FOR SALT EXTRACTION FROM BRINES

Ioan CHINTĂUAN*

Abstract. „*Pan" used for salt extraction from brines.* The wooden pan with holes and axial plugs was identified in the alluvia of the river bed of Pârâul Sărat, blocked at an angle of 25^0 and oriented along the water course within clayey salty muds. The pan is more than 3 m long and, in average, 0,4 m wide; on its bottom, 16 holes (probably out of the 20 original ones) were carved forming an axial alignment, which were found to be filled with strings of twisted hemp. The pan was made of pine (or alder?) tree wood, and the plugs stopping up the holes along its bottom, of elder tree (Sambucus nigra). The pan was used for obtaining salt from brines during prehistoric times.

Surface salt-related phenomena (salty springs and ponds, wells with salty water, saline efflorescence, halophyte plants), as well as the well-known salt-generating Badenian geological formations (salt rock and salt-containing clays) are present at Beclean and in the neighboring area, at Figa (SE), Săsarm (N), Şintereag, Şieu Odorhei, Şieu Sfântu, Caila, Valea Măgheruşului, Blăjenii de Jos (E).

In the first two occurrences (areas with salty soils), we have identified wooden objects, *i.e.* „pans" („troace", or „halauă", in Romanian) that were used by the local communities for obtaining salt from concentrated salt solutions („slatină", „saramură" in Romanian).

At **Figa**, in the place known as „La Slatină" (La Sărătură, Valea Slatinii etc.) along the Pârâul Sărat (= Salty Brook, in Romanian) we have identified an almost intact pan in the brook bed within alluvia consisting of sands, pebbles and bluish-grey salty clayey muds. The pan was oriented along the water flow direction, the brook showing very low debits during the dry seasons; the pan was covered and surrounded by alluvia at an angle of about 25^0, with the intact end oriented downstream and located at about 1.2 m depth, fixed within salty clays.

The pan is 3,19 m long, 0,46 m wide at the broken end, and 0,39 m at the intact end.

Along the median line at the bottom of the pan, 16 holes (of the original 20) with a diameter of 30 mm are located at 12 cm from each other, forming an alignment. Each cavity is stopped up with a plug, between 13-18 cm in length and showing an axial orifice (channel), between 8-10 mm in diameter. The top of the plug (on the pan's side) shows a collar (between 27-40 mm in diameter), to prevent the plug to slip through the hole. In the clay material filling the axial channel of the plug, we have identified a string made of twisted hemp, with a knot at the upper end, again to prevent the plug to slip through the hole. The plugs showing rectangular profiles, with the collars at the pan's side end and the strings towards the inner side, were intact and were fixed within the holes, thus we assume that the pan was not transported together with the alluvia. It was found in/around the same location as the original one, were it used to be utilized.

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The closed end (corresponding to the intact end) of the pan is 19 cm in width, 35 cm in height and 40 cm in length. The bottom of the pan is flat, and the top opening is, in average, 18 cm in length, even if the inside length is 32 cm; thus, the pan was internally carved along the original woods' crust/structure. The wood belonged to a pine (or alder?) tree, and the plugs were built-up of elder tree *Sambucus nigra*).

Based on the summary of the field observations and its peculiar features, we assume that the pan was used for obtaining salt from brines by evaporation.

Regarding the procedure used, we assume that the closed end was fixed on a prop, while the open end fixed on another, shorter support was orientated along the water course, upstream. The open end could be closed by using a small blocking device, which could be used when the pan was filled up. Or, another possibility would have been to have both ends closed, and the same height for the props, thus some wooden bowl would have been used for filling the pan with brines from the salty wells along the brook's bed or in the neighborhood of the river bed.

The salty solutions could leave the pan through the plugs fixed at the bottom of the pan, in fact through the doubly-twisted hemp strings, fixed with a knot at the top of the axial channel. Along/through this rope, water was dipping very slowly, the NaCl solution was diluted, while the brine inside the pan became progressively more concentrated, until reaching the value from which salt started to crystallize. An additional favorable factor for evaporation was represented by the solar heat.

In this way, a large amount of fine, pure salt could be obtained during the warm and sunny seasons of the year in a relatively short time. The salt was removed from the pan through the holes at its bottom, after the plugs were removed. Subsequently, salt was deposited in wooden or ceramic pots. Salt represented an important trade unit for the local communities in the times when the population was not numerous, thus the salt needs were limited. When the request for salt increased, other sources and procedures had to be found, such as massive salt outcrops or subsurface deposits, which were mined at the surface or in the underground.

The salt microdepression Figa („La Sărătură"), drained by the two salty brooks, is characterized by the presence of numerous irregular excavations, partly filled with fresh waters from precipitation, transformed into marshes, or other times dry. The small doline-type excavations (but not related to sinkholes proper) are 2-10 m in diameter, with only one exception represented by the fresh water pond in the western side of the structure, close to the forest border.

The presence of the many doline-type excavations may indicate that periodically, massive salt – located at very small depth – was mined at the surface. At the location of the spring of the salty brook, massive salt was mined at the surface by local people until about 50 years ago, for animal food use.

This statement is also supported by the presence, in the same area, of many other small excavations related, this time, to the archaic/preindustrial, local mining of other rock types.

The surface mining of massive salt does not preclude the prehistorical use of the procedure of obtaining fine salt *via* evaporation from brines by using wooden pans.

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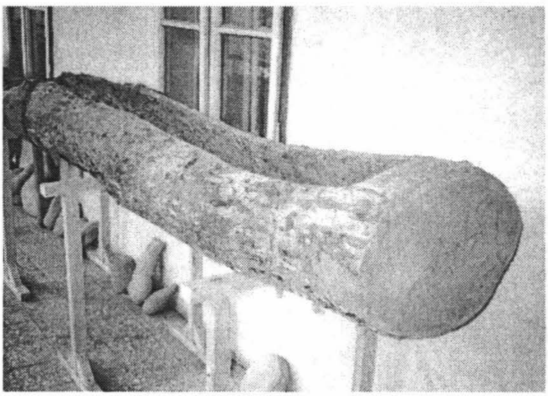
Foto 1. „Troaca" de la Figa (BN) – vas de lemn pentru obţinerea sării din apă sărată
„Pan" used for salt extraction from brines – Figa (BN)



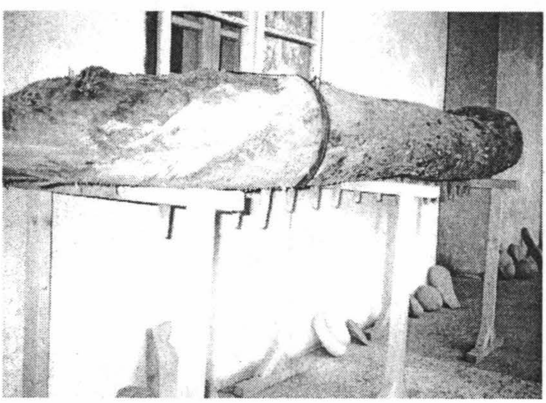


Foto 2. „Cep” – dop cu gaură centrală

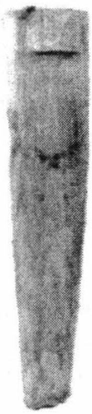


Foto 3. Sfoară de cânepă, în „cep” (împletită şi cu nod la capăt, ca să nu cadă prin gaura cepului, pe care se scurgea apa sărată)

Studii şi cercetări, Geologie-Geografie 10, 2005, Bistriţa, p. 79-86

ANALYTICAL METHODS IN GEOARCHAEOLOGY

Marius HORGA*

Abstract. The paper presents the most important analytical methods that are used in the study of ceramic and lithic archaeological artefacts. Both the classical methods (macroscopic investigation, polarising transmission microscopy, thermal analysis, X-ray diffraction, scanning electron microscopy) and more complex methods requiring specialized equipment: electron microprobe, atomic absorption spectroscopy are presented.
The mineralogical investigation on artefacts provides information on the occurrences (sources) of raw materials, on the technologies used, and thus contributes to their classification and assessment. In consequence, the mineralogical methods are a prerequisite in archaeological studies.
Rezumat. În lucrare sunt prezentate cele mai importante metode de studiu ale artefactelor arheologice de natură ceramică şi litică. Au fost trecute în revistă atât metodele clasice (observaţiile macroscopice, microscopia polarizantă prin transmisie, analiza termică, difractometria de raze X, microscopia electronică cu baleiaj), cât şi metode mai complexe, care necesită o aparatură specială, avansată din punct de vedere tehnologic: microsonda electronică, spectroscopia de absorbţie atomică.
Aplicarea metodelor de analiză mineralogică asupra artefactelor contribuie la identificarea ocurenţelor (surselor) de materii prime, a tehnologiilor folosite la obţinerea lor şi, implicit, la clasificarea şi diferenţierea obiectelor în cauză, fapt care demonstrează necesitatea folosirii lor în domeniul arheologiei.

Introduction

The physical methods used in the study of solid matter are classified into three categories. The first one groups the methods which reveal the microfabric (structure and texture) of the materials, and the type of crystalline phases present, for example, polarizing transmission microscopy, X-ray diffraction, scanning electron microscopy (SEM) and transmission electron microscopy (TEM). A second category includes the methods providing chemical information (e.g. atomic absorption spectroscopy as a method for investigating bulk chemistry, or electron microprobe for local chemistry). The last group refers to the so-called „special methods" which evidence some specific features of the investigated materials: IR, Raman and Mössbauer spectroscopies, electron spin resonance (ESR) etc.

Recently, on a global scale, mineralogical methods found a wide range of applications in non-geological fields, such as historical sciences (archaeology), oxidic materials synthesis, special materials engineering, constructions etc.

Some of the mineralogical analytical methods, especially the classical ones, such as polarized transmission optical microscopy and X-ray diffraction proved to be of a special importance in the study of ceramic and lithic archaeological artefacts. Besides, some

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complex methods performed on sophisticated equipment (electron microscopy, microprobe, spectroscopic methods etc.) provide additional, relevant information.

According to their effect on the studied materials, the mineralogical analytical methods are grouped into non-destructive and destructive methods. More complex information is obtained if both types of methods are used, for example macroscopic investigation, optical microscopy and X-ray diffraction. The non-destructive methods are applied on very valuable and small-sized objects, such as gems (precious stones) within jewels, by using special techniques.

1. Surface macroscopic and microscopic investigation of archaeological artefacts

Investigation of the surface of artefacts is performed by using non-destructive methods allowing observation by naked-eye or by specific devices: magnifying glass, stereomicroscope, polarizing reflexion microscope, scanning electron microscope. For example, in the case of ceramics macroscopic and microscopic porosity, colour, grain-size distribution, presence/absence and colour of engobe, traces indicating the modelling/forming procedure, type and decoration technique can be thus investigated.

In the case of lithic objects (consisting of minerals and rocks) information is obtained on colour, structure and texture, compactness, surficial alteration, stage reached by forming and degree of usage.

In the view of a correct characterization of the potsherds and lithic materials, the physical, macroscopic investigation has to be completed by microscopic studies.

2. Transmission polarizing microscopy

Being one of the optical analytical methods, transmission polarizing microscopy is based on the study of the optical properties of minerals in thin sections (slices not more than 20-25 μm thick) prepared from minerals, rocks or synthetic materials which become, in this way, transparent to the polarized light beam. The thin section consists of a slice of the studied material with an area of at least 1-2 cm^2, glued by using Canada balm or amorphous synthetic resin (refractive index of 1.54) between a glass plate and a glass lamella. The investigation is performed under a petrographic microscope by using parallel or convergent polarized light.

Transmission polarizing microscopy provides important information in the following types of investigations:

1. Fabric investigation (structure and texture) of homogeneous or heterogeneous systems such as monomineralic or polymineralic masses (rocks, mineral aggregates, synthetic materials);

2. Mineral identification based on morphology, optical characteristics, optical symmetry and relationship between crystallographic and optical symmetry;

3. Evidence on polymorphic transformations and on reaction areas in solid phase or in melts;

4. In the case of ceramics, features such as microfabric, mineral composition, structural and compositional homogeneity, presence and type of lubricant, as well as its grain size, porosity, intensity of vitrification process can be defined (Ghergari and Ionescu, 2000). The observations are based on comparison with already-known rocks and minerals and they sometimes lead to precise characterization of the processing technology and identification of the source for the raw materials. In the same time, the firing temperature of the ceramics can be defined by microscopic observation of reaction zones and transformations of specific primary minerals in the clay mixture. Especially carbonates (calcite, dolomite, siderite), iron oxy-hydroxides (hematite, magnetite) and some sulfides (pyrite) provide indications on the thermal regime.

For ceramics, the orientation pattern of lamellar minerals (micas and clay minerals) relative to the ceramic external and internal walls, as well as within the ceramic body offers important clues in establishing the type of the forming procedure used (handwork or wheelwork, *i.e.* by using the potter's wheel). According to Ghergari and Ionescu (2000), the following features are significant:

– the orientation of the lamellae parallel to the ceramic wall along the whole thickness of the body indicates wheelwork forming;

– the orientation of the lamellae parallel to the ceramic wall may be also obtained by pressing – striking; in this case the orientation is preserved only till the clay plates' joint;

– the presence of an orientation pattern in the central part of the ceramic body and changes in orientation towards the wall – sometimes in a diagonal position or randomly at the periphery, the features being more pronounced close to one wall surface as compared to the other are evidences for forming by using variously-shaped clay balls fixed on a head; these were joined by overlapping the margins, while the outside wall was handworked;

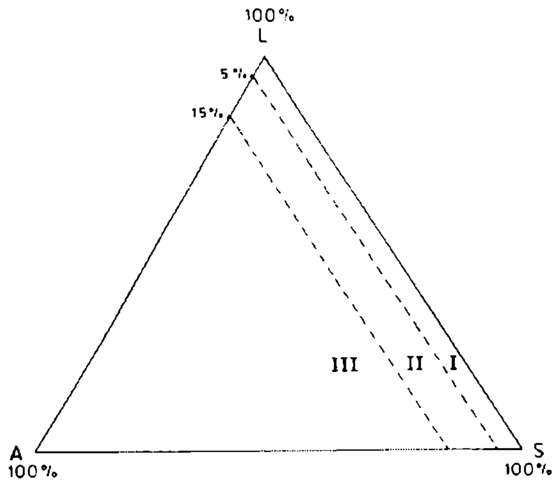
– the absence of a preferential orientation of the lamellar minerals, *i.e.* obvious changes of their orientation on small areas pleads for the forming on a mould, by pressing the clay coils.

The investigation of ceramic archaeological materials by using the transmission polarizing microscope also involves their classification according to grain size (defining the ceramic's fineness). This can be done based on the relative participation of some mineral components (clasts and matrix) assigned to standard granulometric categories. The best results are obtained by using planimetry (on thin sections cross-cutting the wall of the ceramic item). For the measurement, one may use micrometric networks or the integrating stage. The procedure can be applied also to microphotographs of the studied materials.

The degree of fineness can be accurately defined by calculating the average value resulted after measurements on several thin sections.

The classification of a ceramic sample based on grain size and the definition of the ceramics' fineness (*i.e.* fine, medium-grained or coarse ceramics) is based on plotting the measured relative amounts, after normalization to 100%, in the ternary diagram L(utite) – S(ilt) – A(renite); the ruditic fraction is summed up with the arenitic fraction (Fig. 1).

Fig. 1.
Ternary diagram L(utite) – S(ilt) – A(renite-rudite) including limits for the granulometric categories, and fineness degree (Ghergari et al., 1999): I – fine ceramics, arenitic fraction < 5%; II medium-grained ceramics, arenitic fraction 5-15%; III – coarse ceramics, arenitic fraction > 15%.



3. X-ray diffraction

The method is based on the X-rays diffraction phenomenon within crystalline lattices. This method is destructive – being performed on powders obtained by grinding the studied materials (minerals, rocks, ceramics) and provides data complementary to microscopic studies.

X-ray diffraction (XRD) offers accurate qualitative and quantitative information on the phases present in the sample. Besides, structural modifications of some minerals during firing (especially in the case of clay minerals) are pointed out. Crystal orientation and crystallinity degree of specific minerals are other issues to be addressed by this method.

The main raw material for ceramics is clay, dominated by phyllosilicates such as: kaolinite, illite, montmorillonite, mixed-layers illite/montmorillonite and vermiculite, accompanied by grains of quartz and feldspars, lamellae of muscovite, biotite, chlorite and various heavy minerals.

The X-ray diffraction method on powders enables the identification of the crystalline phases present in the ceramic mass. By using a quantitative evaluation method (e.g. the proportional constants method), also the phases' relative amount can be defined.

An accurate assessment involves a priori the microscopic evaluation of the amount of amorphous or glassy phases.

Another application of XRD method is related to the firing temperature of the ceramics. This evaluation is based on the specific transformation, or structural breakdown temperatures for the clay minerals. The structural changes of clay minerals under the effects of increasing temperature during firing are marked by changes in the intensities of some diffraction peaks or even by their absence from the XRD pattern (indicating the collapse of the structure). These changes consist of a series of reactions taking place within specific temperature intervals, defined by specific patterns for each mineral. Examples of such structural transformations leading to changes of the XRD pattern are: dehydration, loss of zeolitic water, dehydroxilation, irreversible polymorphous structural modification, partial decomposition (e.g. dolomite decomposes as calcite and amorphous MgO) to complete structural destruction.

The firing temperature evaluation in the case of clay minerals mixtures is based on changes recorded by the (001) series of reflexions (increase/decrease of intensity, or disappearance of the peaks). The basal peak of a clay mineral corresponds to the diffraction line obtained from the crystallographic planes (001) and it indicates the distance between two elementary 1 : 1 or 2 : 1 units along a perpendicular direction. The loss of water from the interlayer, *e.g.* in the case of montmorillonite takes place up to 250°C (at higher temperatures the expandability of these minerals is lost). This is accompanied by the shift of the basal line from d=15 Ĺ (Ca-montmorillonite), or 11-12 Ĺ (Na-montmorillonite) to d = 9.6 Ĺ. The next modification is represented by dehydroxilation (at around 700-800°C), when the basal line disappears from the XRD pattern. Another example is represented by kaolinite and the related minerals of the same composition (dickite, nacrite), showing a basal line at about 7 Ĺ. The dehydroxilation of these minerals takes place in the 500-650°C interval; at higher temperatures the basal line disappears. In conclusion, the basal reflexions represent the most important parameters in the evaluation of the firing temperature of the clay minerals, and of the modifications during the thermal treatment applied to the ceramics.

A preliminary evaluation of the quality of the firing (good, medium or bad) underwent by the ceramics can be done by assessing the crystallinity degree of the mica lamellae resulted by the calcination of the clay minerals (Ghergari and Ionescu, 2000).

The XRD study of ceramic materials showed that also the phase transformation of clay minerals during firing can be evidenced. According to Herz and Garrison (1998), at temperatures above 550°C the clay minerals may become amorphous, while above 1000°C they may be vitrified and recrystallized, resulting in the formation of mullite and cristobalite.

4. Thermal analysis

Thermal analysis is a destructive method involving progressive heating of the sample from 25°C to 1000°C or even more, while recording the endothermic and exothermic reactions (DTA), as well as the weight loss or gain (TG).

Among the various thermal analytical methods, the ones with the most convincing results in the study of solid matter including mineralogy, are thermal differential analysis, thermogravimetry and differential thermogravimetry (Todor, 1972). Thermal derivatography groups together all these techniques, applied on the equipment called derivatograph.

Thermal analysis is used for mineral identification based on the temperatures of transformation. Each species is characterized by typical endothermic and/or exothermic reactions. The behaviour upon firing of mineral mixtures can also be studied by using this method.

In the case of ceramic materials, thermal analysis points out to the endothermic or exothermic effects that have not been active during firing. In some cases, the structural collapse under increasing temperature is irreversible; thus, the thermal effects caused by the irreversible reactions will not take place when the sample is heated for the second time. The temperatures of structural breakdown, dehydration (loss of H_2O) and dehydroxilation (loss of the OH^- groups) have specific values in the case of each mineral species. However, some of the previous endothermic effects may be repeated (e.g. dehydroxilation or decarbonation) if the firing temperatures were not high enough for complete irreversible reactions to take place. Frequently, effects produced by loss of remnant OH^- and CO_2 can be noticed.

5. Scanning electron microscopy (SEM)

In comparison with transmission electron microscopy (TEM), the scanning method has a lower resolution. This means that for an accurate identification, it is recommended that the studied crystals to be larger that 0.5 μm.

Usually, the scanning electron microscope is used for morphological characterization of crystals. Surface features (aggregates, pores, geodes) related to alteration-transformation processes can be studied, as well as identification of mineral assemblages based on their specific morphologies. All these criteria allow the classification of the studied materials.

SEM images on ceramic fragments evidence their porosity (pores' shapes and sizes) and the reaction products at the crystalloclasts' and lithoclasts' interface with the clayey matrix. Thin films or larger amounts of glass and development of closed pores can be visualized. When the equipment includes an energy-dispersive X-ray detector (EDAX) also chemical information can be obtained from polished surfaces on the sample, allowing for example the study of elemental diffusion at the border between crystalline and amorphous phases.

6. Electron microprobe analysis (EMPA)

Electron microprobe method provides local chemical information on very small areas (surfaces of about 1μm^2) considered as spots (the depth of beam penetration is of a few μm), as well as on microinclusions in minerals, rocks, ceramic materials etc. Additionally, zoning in minerals or other types of materials, diffusion studies in solid matter and chemical transfer at phase boundaries can be studied by EMPA.

7. Atomic absorption spectroscopy (AAS)

This qualitative and quantitative chemical method of elemental evaluation in minerals, rocks, synthetic materials etc. is performed on an analytical equipment consisting of:

a. Source of radiation. For each investigated chemical element the source is represented by a lamp with concave cathode obtained from the respective hyper-pure element;

b. Sample pulverized in flame or plasma (ICP). The un-excited atoms present as vapours adsorb the radiation from the source (having the same wavelength as the investigated element);

c. Monochromator; d. Detector; e. Recorder.

The amount of adsorbed radiation is proportional with the elemental concentration in the investigated sample. For the quantitative measurement, a calibration curve has to be built by using standard solutions.

Conclusions

The application of mineralogical analytical methods in archaeology, especially in the case of ceramic artefacts, leads to the identification of their physiographical characteristics (structure and texture) and their phase composition. With certain limitations, the technological stage reached by specific cultures concerning forming, decoration and thermal treatment (firing) of ceramics and typical raw materials can be deciphered. The detailed knowledge on the mineralogical and chemical composition allows an accurate classification of archaeological ceramic artefacts and reveals details on their provenance.

As far as the lithic artefacts are concerned, establishing the petrographic type, the chemical and mineralogical composition enables the accurate identification of the level of technological development reached by a distinctive population in processing the respective objects, of their destination and usage degree, as well as of the sources for the raw materials.

By including mineralogical and petrographical information in the archaeological data bases, further comparative scientific studies would stand on more solid grounds.

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Studii şi cercetări, Geologie-Geografie 10, 2005, Bistriţa, p. 87-90

DIE ACTIVIERTEEN VERMITTERUNGEN DER RESTAURATIONSEINGRIFFE

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Zusammenfassung. Eswird die Klausenburger Franziskaner Kirche geforscht, in deren Gebaüde ein Sälzekomplex aus der Na sulfatgruppe mit den an der Tagestemperatur empfindlichen Hydratationsstufen identifiziert worden ist. Die von den Wassermolekulen abhägige Variation des Volumes führt zu einem spannenden, von der Variation des molekularen Volumes verusachten Bewegung des mechanischen Stresses. Dessen Folge ist die Ausscheidung der Tünche an den über 1,5 Meter hoch befindlichen Wändenoberfläche. Man berechnet die in den hydratierten und unhydratierten Extremen erscheinenden Volumenvariationen sowie auch die innerhalb der Tünche dieses Denkmal sich bewirkenden Vorgänge.

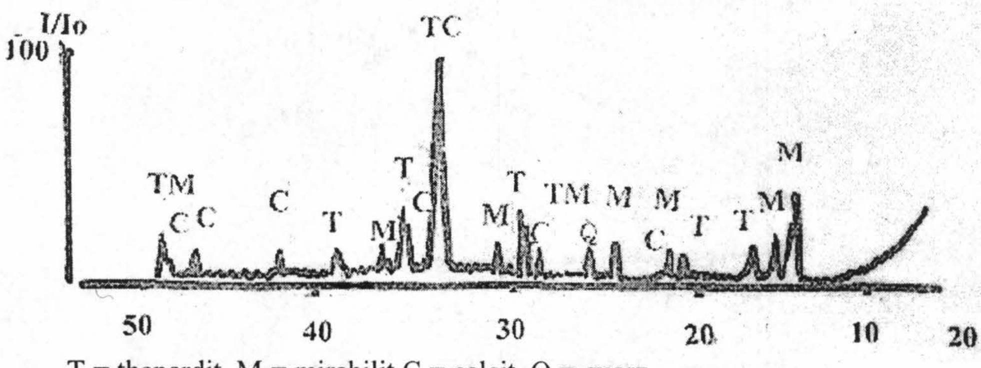
Die Franziskanerkirche aus Klausenburg war auf der Aussenseite durch Arbeiten die in mehreren Etappen stattgefunden haben, restauriert.

Die letzte grosse Arbeit war zwischen den Jahren 1998-1999 abgeschlossen. Die Salzlösungen die durch den frischen Bewurf hinzugefügt waren, fügten sich den Salzen, die in den Poren des Ziegels (Backsteines) vorhanden waren, hinzu und *aktivierten* sie.

Bei diesem Denkmal handelt es sich um die Aufblätterung des Bewurfes auf der Westseite. Wir finden auch andere Verwitterungsformen wie z.B. die Aufblätterung der Kalksteinplatten, schwarze Krusten (dunkle oberflächenveränderte Krusten) und mikrobiologische Besiedlungen (Flechten). (Duca ş.a., 1998, 1999, Duca (a) 2003, Duca (b) 2003).

Die RX Analyse identifizierte bei dem Kontakt Bewurf-Ziegel Natriumsulfate Typ Thenardit Na_2SO_4 und Mirabilit $Na_2SO_2 \cdot 10H_2O$ (Abbildung 1).

Abbildung 1. Interpretation des RX-Difraktogramms, welches auf dem Na-Sulfat Probefragment durchgeführt wurde



T = thenardit, M = mirabilit,C = calcit, Q = quarz

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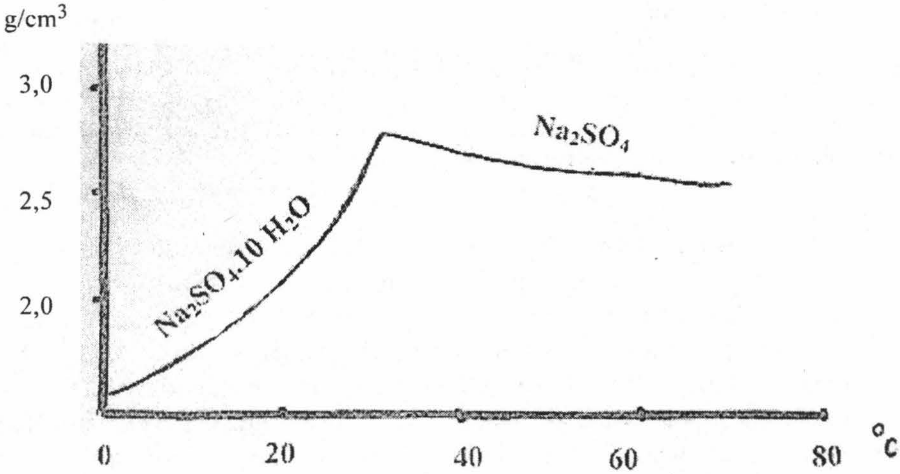
Unter 23°C Temperatur ist die stabile Form das Mirabilit. Durch Aufwärmung findet eine stufenartige Ausscheidung des Wassers start.

Masside und Sana (2002) erwähnen bei Temperaturen über 23°C einen instabilen Bestandteil Typ $Na_2SO_4 \cdot 7H_2O$. Nach anderen Verfassern, gibt es gegen 32°C noch einen instabilen Bestandteil: $Na_2SO_4 \cdot 5H_2O$ und über 32°C bildet sich Thenardit.(Abbildung 2)

Abbildung 2. Graph der Dehvdrierung des Na-Sulfates abhaengig von Temperatur



Das Molarvolumen des Thenardits ist 53 cm^3/mol, und erreicht durch nacheinanderfolgende Hydratierungsetappen 220 cm^3/mol beim Mirabilit.(Abbildung 3).

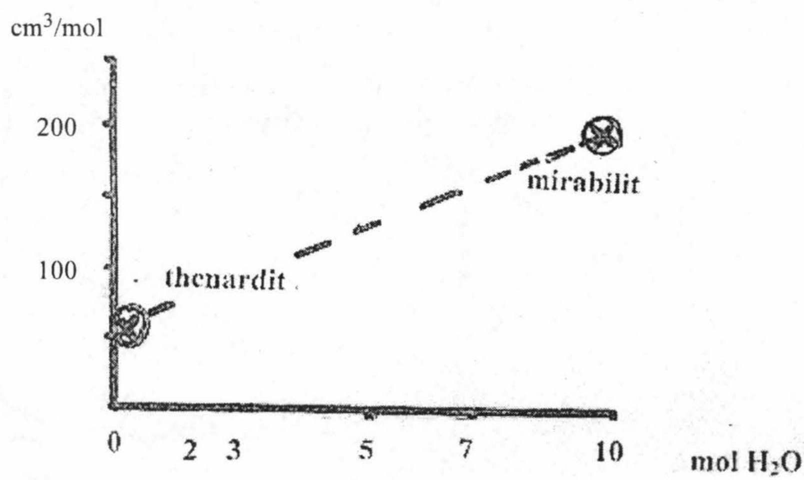


Abbildung 3. Die Volumenanderung des Molarvolumen abhangig von den Hydratierungsgrad des Na_2SO_4

Es folgt dass Temperatur und Feuchtigkeit die Anzahl der Wassermolekuele, welche sich zur Basiskomponente Na_2SO_4 hinzufügen beziehungsweise daraus entfernen, kontrollieren.

Bei 80-90% Feuchtigkeit und 20°C Temperatur ist der Druck, der bei dem Kristallisierungsvorgang entsteht, zwischen 16-33 MPa (Massida, Sana, 2002).

Die Erhöhung der Temperatur bei verschiedenen Stunden des Tages bis zu 25°C, ergibt die Verminderung der Molekuele, die im Kristallohydrat waren, und somit ist auch der Druck gegen 7-24 MPa.

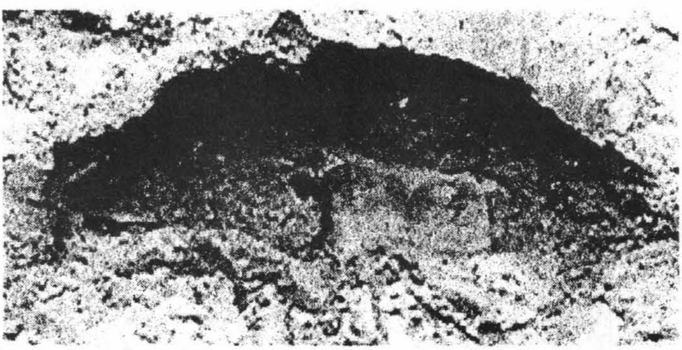
Ueber 32 ° C kristallisiert das Thenardit und erzeugt einen Druck, welcher maximal 9 MPa erreicht.

Es folgt, dass im Sommer bei Regenwetter, die Sonnenstrahlung tagsüber das Molarvolumen des Sulfates bis zu 53 cm^3/mol vermindert und nachts die Feuchtigkeit und die Temperatur unter 20°C das Entstehen (bei einem Druck ueber 33 Mpa) (Massida, Sana, 2002) des Mirabilites mit einem Molarvolumen von 220 cm^3/mol begünstigen.

Der Kristallisierungsdruck wird auch von einem anderen Strukturbestandteil kontrolliert, welcher der Porendurchmesser ist. Je kleiner diese Porendurchmesser sind, desto groesser ist der entstandene Druck (Duca (c), 2003, Duca, 2000).

Wenn die intensive Verdampfung auf der Bewurfsoberfläche die Transportgeschwindigkeit der Losungen aus den Poren ueberschreitet, entstehen Subfloreszenzen beim Kontakt Bewurf-Ziegel, welche Aufblaetterungs – und Zerfallsdruck erzeugen (Abbildung 4)

Abbildung 4. Aufblatterung des Bewurfs
unter dem Druck der Kristalisierung der Salzen aus den Ziegeln



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Studii şi cercetări, Geologie-Geografie 10, 2005, Bistriţa, p. 91-94

THE ENVIRONMENTAL IMPACT OF THE WASTE STORAGE FROM BLAJ (ALBA DISTRICT)

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Abstract. Blaj is an important town located in SW Transylvanian Depression. The town waste storage is situated in its NE vicinity, on the left bank of Târnava Mica Valley. This location is an appropriate one, as it is placed sufficiently far from the town. However, the analysis carried on several samples of water and soil evidence that a pollution of underground water remains possible as far as the waste is in direct connection with the Sarmatian sand bedrock. In these circumstances, the surface waters can carry into the aquifers polluting elements, altering the native quality of water. Surface pollution is also always possible, affecting the soil fertility and surface water. Several prevention actions can be done in order to avoid such consequences.
Key words: Transylvanian Depression, Blaj waste storage, pollution.

Introduction

The waste pollution is a notorious environmental problem in our country. In the last years, it took place eloquent legislative canvas turnover concerning the waste processing. As opposed to the European Union (E.U.) countries which adapted their legislation on long time spans (over than twenty years), Romania had to solve it in an extremely short interval comprised between 2000-2003, when the main E.U. directives concerning wastes have been engrafted into the Romanian legislation. As a consequence, a preliminary identification and assortment of municipal waste storages falling under E.U. 1999/31 Directive was done. The storages excepted by this directive (located in lonely settlements) will be further identified. In the whole national territory, the situation is the following one: three settlements fit well with the directive exigencies, eleven will became until the end of 2006 and two hundred fifty one cannot be considered admissible and will be gradually closed, in parallel with adequate new storages.

In the municipal waste storages, beside the usual municipal waste, by contract one can store also industrial harmless waste.

If the term „municipal waste" is well defined by HG 162/2002 and concerns the usual local engendered garbage and other wastes attributable to garbage, for the industrial waste one not dispose of a precise definition, neither in the European, nor in the national legislation.

The environment problems related to this kind of storages consist mainly on the liberation of different chemical substances either already existing into the waste or new formed pending the storage, of dust and ash resulted trough the activities unreeled on the storage location. Some other details are also relevant, as it will be pointed out further.

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Blaj municipal waste

Blaj town is located on Târnavelor Plateau, at Târnava Mare and Târnava Mică valleys confluence, on Secaş – Târnave plateau (450 m height). The DN 14B road links Alba-Iulia to Mediaş.

The geology of the area concerns Middle Miocene (Sarmatian *s. str.)* formations, forming a NW-SE anticline. Lithology is dominated by clastic and terrigenous rocks (marl, clay, sand; Stanciu & Stoicovici, 1944; Giuşcă et al., 1967). Soil covers the Middle Miocene deposits.

The municipal waste storage is recorded in the public domain of Blaj Municipality trough the local council decisions # 107/1999 and 90/2001. It was designed by URBANA Society, then undertook by I.G.C.L. Blaj between 1981-1990. In 2001, trough the association contract between Blaj town hall and TRANSPORTWEBER Ltd., the last partner undertook the waste storage and will process the waste on the following ten years.

After thirty years, one asses that the storage will reach its maximum capacity.

Location

The waste ramp is located NE from Blaj, on the left bank of Târnava Mica. The departmental road 107 linking Blaj to Sincel provides the access to the waste ramp. The location site disposes of a series of advantages, as: closeness to the town of the waste ramp (three km only), allowing a low fuel consumption; no valuable agricultural field is lost, as the waste storage is located into a ravine with low agricultural productivity; dominant wind blows from the Blaj side; in this manner the gas resulted trough putrefaction and degradation do not pollute the town, but is carried away on opposite directions; garbage ramp is far enough from Târnava Mica Valley, without an impact of the water stream; small distance between the storage and the road linking Blaj to Târnăveni avoids high investment on additional approach.

As a whole, one can consider that this location corresponds to the legal exigencies.

Collecting, carriage and storage of municipal waste

For the whole specific activity related to Blaj town, TRANSPORT WEBER Ltd. disposes of an adequate technical endowment.

The waste collecting is done with two garbage trucks. For the same activity, the society has at its disposal: thirty eight recipients Eurotrash-type cans and fifty containers. For instance, the garbage is not selected through different waste-types, but the whole quantity is transported and stocked at the ramp. The recycling and processing of different types of wastes (glass, plastic etc.) can not be done in this phase.

The garbage transport and distribution into the cesspool are done by one Mercedes compactor, one Saviem compactor, one tractor, one S 650 bulldozer. The garbage is primarily stocked on the ramp then it is leveled with the bulldozer.

The ramp technology concerns the waste pushing, leveling and compaction into 1.5-2 m thick strata. Each compacted strata is splattered with lime cream diluted solution, than covered with waterproof compacted clay, 20-30 cm thick. For instance, the deposit height attains 7 m.

On a year 20, 000 m^3 of waste are stocked. According some estimations, 250 000 m^3 will be stored here. For instance, 42% of the whole stocking capability is already occupied.

Evacuation of polluted water

The improper processed wastes, as well as their decomposing constituents washed by rainfall, can get into soil (Tab. 1). Concentrations of the measured soil parameters falls within the limits imposed by the Ord. 756/1997.

However, the pollution can extend on large areas, trough surface or underground water (Tab. 2). The final decomposing constituents of organic wastes, in contact with rainfall water will alkalinize as salts, especially nitrates and sulphates, finally altering the water quality and increasing its hardness. For instance, the location is devoid of drinkable water supply.

Tab. 1.

Soil analysis on samples collected from different sites in the waste ramp vicinity

#	Parameter	U/M	Measured value	Standard values Treshold/employments less sensible	
				Alert	Interventions
1	Total Cadmium	mg/kg	0.10-0.17	5	10
2	Total Lead	mg/kg	8.7-11.2	250	1000
3	Fluorine	mg/kg	5.9-8.0	500	1000
4	Free Cyanides	mg/kg	0	10	20
5	Phenols	mg/kg	0.1-0.3	10	40
6	Sulphates	mg/kg	-	5000	50000
7	Policyclic aromatic hydrocarbons	mg/kg	0	25	150
8	Hydrocarbons from oil	mg/kg	1.0-2.5	1000	2000
9	Copper	mg/kg	6.5-9.5	250	500
10	Nickel	mg/kg	0.43-0.68	200	500
11	Zinc	mg/kg	420-485	700	1500
12	Manganese	mg/kg	542-560	2000	4000
13	Chrome	mg/kg	8.8-12.4	300	600

Noise

The ramp noise is induced by the transport and flattens engines that are the two compactors and the bulldozer. This noise intensity is under the admissible values, so the phonic pollution is out of question as far as the settlements are far from the ramp.

Conclusions and sugestions

As a consequence of the studies and observations collected in several field missions, a potential soil and water pollution can be outlined. In these circumstances, some preventive actions can be suggested, in order to decrease the environmental impact: pollution prevention

Tab. 2. Analysis concernind the surface water from Blaj waste ramp. The first value concerns the water up the ramp and the second one the water downstream the site.

The water samples do not accord with the limits imposed by NTPA 001/97 for residual waters ejected into water resorts.

A part of rainfall that reaches the ramp trough seepage can alter the underground water table. Another part can pollute the surronding areas. It is obviously clear that the crop area contamination, as well as casually pollution determined by floods should be forewarned.

#	Quality index	U/M	Measured value	Maximum concentration of pollutants ejected into:	
				Water resort NTPA 001/97	Sewerage system NTPA 002/97
1.	(NH_4^+)	mg/dm³	1.4/2.3	2,0	30
2.	(NO_2)	mg/dm³	0.55/0.35	1	-
3.	Extractible substances	mg/dm³	2.5/5.2	5,0	20
4.	CCO-Mn	mg/dm³	72.5/86.3	40	-
5.	CBO_5	mg/dm³	16.8/28.4	20	-
6.	O_2	mg/dm³	1.3/0.5	-	-

of soil, surface and underground water trough some additional improvements (channels, sewer located downstream); the basement of the ramp could be insulated from the bedrock either by a geo-membrane, or by battered clay; incessant soil and water quality monitoring; ramp endowment with still missing utilities (potable water and electricity); accurate technology of dumping; protection of the site against intruders (enclosure and guardianship) and fire protection; purveyance of minimal hygiene exigencies, including regular disinfection by professional society.

This research has to continue in order to draw up a hazard evaluation and recommended program for framing in environment laws exigencies.

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GEOGRAPHY

HAZARD PHENOMENA WITHIN THE AREA OF THE MAGMATIC MASSIFS ŢIBLEŞ AND TOROIAGA

I. BÂCA*

Abstract. The intrusive magmatic massifs Ţibleş and Toroiaga constitute complex morphosystems endangered by certain occurring energetic, chemical, functional and morphological mutations, a fact that is meant to redefine and readjust the morphogenetic relations within them, as well as the local and regional geographic equilibrium. Henceforth, the hazards can be divided into two major categories: **natural hazards** and those **induced by anthropic activities.** The natural hazards are conditioned by natural factors and represented by climatic and hydric hazards. Those induced by anthropic activities have as result human intervention on the natural elements of this region and are represented by morphological, chemical and ecological hazards, fairly noticeable within the landscape.

Key words: natural hazards, hazards induced by the anthropic activities.

The intrusive magmatic massifs Ţibleş and Toroiaga constitute complex morphosystems endangered by certain occurring energetic, chemical, functional and morphological mutations, a fact that is meant to redefine and readjust the morphogenetic relations within them, as well as the local and regional geographic equilibrium. Henceforth, the hazards can be divided into two major categories:

– **natural hazards,** conditioned by natural factors, such as climatic and hydric hazards;

– induced by **anthropic activities**, such as the morphological, chemical and ecological **hazards**.

The climatic and hydric hazards are function of the latitude position of the two massifs, under the influence of the western and north-western air streams, of their orientation towards north-west-south-east, of their relatively high altitude and of the features of their hydrographic systems. The pouring rainfalls in the period of May – August are extremely aggressive and facilitate the processes of washing, streaming and pouring, which determines the turning up of some specific morphological formations on the front part of the slopes, especially in the over-depasturaged and cleared land sectors. The reactivation of the torrential valleys has as a result in certain places the traffic blocking, because of large deposits of detritus at the contact with the roads, as in the case of the Ţâşla and Colbu valleys in Toroiaga. The melting of the abundant snows at the beginning of spring often leads to the occurrence of some nivo-torrential phenomena with a great impact from a morphological and economic point of view. The streams to concentrate on some torrential valleys involve a large mass of snow and detritus, contributing at their shaping and at the formation of some immense dejection cones at the slopes foundation, as in the case of the valleys of Secu, Măcârlău and

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Colbu, in Toroiaga. On the valley of Secu, such phenomena often block the mining road towards Gura Băii and affect the constructions in this sector. As a counter-measure, avalanche bridges were built in order to re-direct the material and energy flows over the road and to dissipate them on the slope which overlooks the valley of Secu.

The big duration of the frost phenomena within the two massifs favors the decomposition processes that affect the natural and anthropogene slopes The rainfalls during the spring season, associated with the snow melting, cause the reactivation of torrential activity and the raise in volume of some rivers, a phenomenon that leads to important morphological transformations, with consequences on some anthropic activities. This way there takes place the gathering of detritus material within the torrential riverbeds, their strong shaping, the formation of some dejection cones with great dimensions, the disruption and breaking of some access roads on the larger valleys (Colbu, Novăț, Măcârlău, Izvorul Neted etc.), the occurrence of some crumbling and breakdowns at the foundation of the limitrophe slopes, the destruction of the clarifying ponds on Novat and Colbu, as well as the entrapment of the sterile in some heaps. During our forays through these areas we ascertained morphological changes in the inferior plan of the visible valleys from one year to another. So as to prevent such phenomena, on certain valleys there were built dams (on Colbu, Netedu, Recele) and dykes (on Țâşla). The strong winds that affect the two massifs cause the uprooting of the trees on the western slopes, a phenomenon with important morphogenetic consequences, as the turning up of some excavations, of some breakdown precipices or certain crumbling, on which the modulating processes will occur.

The hazards induced by anthropic activities are numerous and influence all the environmental components. Pasture, clearing, mining, transport and domestic activities contribute to the apparition of some morphological, chemicai and ecological hazards to cause important transformations in the landscape. ***The morphological hazards*** are the most significant ones under a phenomenological aspect, being conditioned, apart from anthropic actions, by the morphometric parameters of the relief, by the detritic character of the superficial deposits, by the rainfalls, etc.

Pasture, intensely practiced throughout the two massifs, at over 1400 m, causes the vulnerabilisation of the slopes and the occurring of some material, energetic, physiognomic and functional changes at this level. The sectioning of their surface and the apparition of the biogene paths favor the installation of the washing, streaming, suffusion and gelifluxion processes, that contribute to the uncovering of the detritic fund and the shaping of specific morphological formations such as detritus fields, drains, beds, and fairly seldom ravines Also, within the sheepfolds, the vegetation is often entirely extinct, and the soil is subject to erosion, as it can be seen on the tops of Neteda, in Țibleş and Măcârlău, Piciorul Țiganului and Piciorul Gradului, in Toroiaga.

The clearing practice in total or partial system gives way to streaming and washing, and log pulling creates ditches which are rapidly taken by streaming and then enlarged, being transformed gradually into real torrential organisms. The placement of forest roads in certain places facilitated the installation of the erosion processes and the apparition of some ditches and beds that evolve continuously. The transport activities on some valleys (Țâşla, Colbu, Secu etc.) cause vibrations to affect the anthropogenuous slopes and facilitate the crumbling and breakdown processes, with material deposists at the slopes' foundation under the shape of piles and detritus feet.

Mining activities and the associated activities induce the main morphological, chemical and ecological hazards within the two massifs. The extraction of polimetallic sulfurs took place in the underground, and thus the edifices of the two massifs were pierced through by lots of galleries, horizontal and vertical, and the explosions used to dislocate the minerals emphasized the preexistent fractures and caused new cracks, which increased the risk of crumbling or breakdown in the massifs' immediate vicinity. The placement of mine mouths and roads caused the sectioning of the slopes' surface and the apparition of anthropogenuous slopes that keep on evolving by retreat.

Apart from these forms of erosion there appeared some stocking structures, represented by immense heaps of sterile, disposed on the slopes, with a distinct environmental impact. These represent morphological formations with an accelerated dynamics, due to their detritic structure, their large-dimensions and the presence of some hydrographic branches in their vicinity. The streaming processes have as result the apparition of some culvert systems on the heaps' piles, with an unceasing tendency. In the areas where the heaps are near certain water flows or are drained by the streams to exit the galleries, there occurs the undertaking of detritic material and its redistribution, which causes the overloading of waterbeds, the raising of draining bed and the decreasing of erosion force in favor of transport. The heaps at a high altitude and on steep slopes have the tendency to extend by rolling and crumbling, stimulated by streaming and nivation or undermining erosion of the waters that exit the galleries and infiltrate in their mass. For this reason, so as to fix them, they proceeded to the fitting of agglutinations and planting of certain tree species. Big hazards are represented by the heaps resulted from the mud elutriation at the flotation Baia Borşa, situated on the inferior valley of Colbu, on Novat and on Tâşla, downstream of the confluence with the valley of Fatu The first two heaps are active and the third one is inactive, *its pile being* mostly covered by forest vegetation (poplar, alder-free, willow-tree). These formations are rapidly evolving under the streaming processes to affect their pile, giving birth to some branched systems of culverts and beds. The loose states of the deposits favors the infiltration of the waters from some torrential organisms which outlet upon heaps or of the waters slooped by the main streams, captated by canals (Novat, Colbu), which starts suffusional processes, undermining them.

The chemical hazards are caused by the trickling of mine waters filled with oxides in the main collectors, by the trickling of waters that wash the heaps of rough and flotation sterile and by accidental pollution, caused by the destruction of the dams from the clarifying ponds and the damaged transport pipes of the sterile from the flotation of Baia Borşa. The mine waters that drain the extraction galleries contain lots of oxides, salts and heavy metals, affecting the water quality and the aquatic biocenoses. So as to avoid this phenomenon, on Izvorul Rău, in Ţibleş, they're about to start a purification station for the waters to flow out of the two galleries here and pollute the Bradului valley and furthermore the river of Lăpuş.

Also, the streaming and washing processes to occur on the heaps of rough or flotation sterile involve oxides, heavy metals and cyanoses that end up in the rivers. The flotation sterile characterizes itself by big suspension for values, alkaline pH, fixed residuum, etc., proving as an extremely harmful pollution source.

The accidental pollution of waters can be caused by the destruction of the dams from the clarifying ponds, as on the spring of 2000 on the Novăț river. Thus, the heavy rains, mixed with snow melting, caused the flow volume to grow and the waters to flow aside the caption canal, across the clarifying pond and breaking its dam. This way, the Novăț river was filled with flotation sterile that was then transported towards Vaser, Vişeu and Tisa, starting a real ecological scandal. As well, the damaged transport pipes of the sterile from the flotation of Baia Borşa towards the carifying ponds on Colbu and Novăț cause the acid waters filled with ions of heavy metals to trickle and affect the underground waters and those of the Țâşla river.

The sustained lumber manufacturing has lately caused the apparition of many sawdust piles along the valleys of Secu and Țâşla. By decomposing, these will release phenol, which will affect the underground waters and the waters' chemistry. The domestic activities in the city of Baia Borşa produce large quantities of residual materials which, due to the absence of an ecological garbage ramp, are deposited on the sides of the road on the valley of Țâşla or at the mouths of Armies, under the shape of immense heaps that facilitate the spreading of microorganisms.

In conclusion, we ought to emphasize that the two magmatic morphosystems are characterized by a dynamic geographic equilibrium, being susceptible for the occurrence of some specific hazards, as a result of the geomorphoclimatic parameters and of the economical activities, hazards that bring important material and functional changes in the landscape (fig. 1 & 2). Henceforth, the relations between man and natural elements have to be reconsidered and an increased care should be taken in what concerns preventing and fighting the hazards in the two regions.

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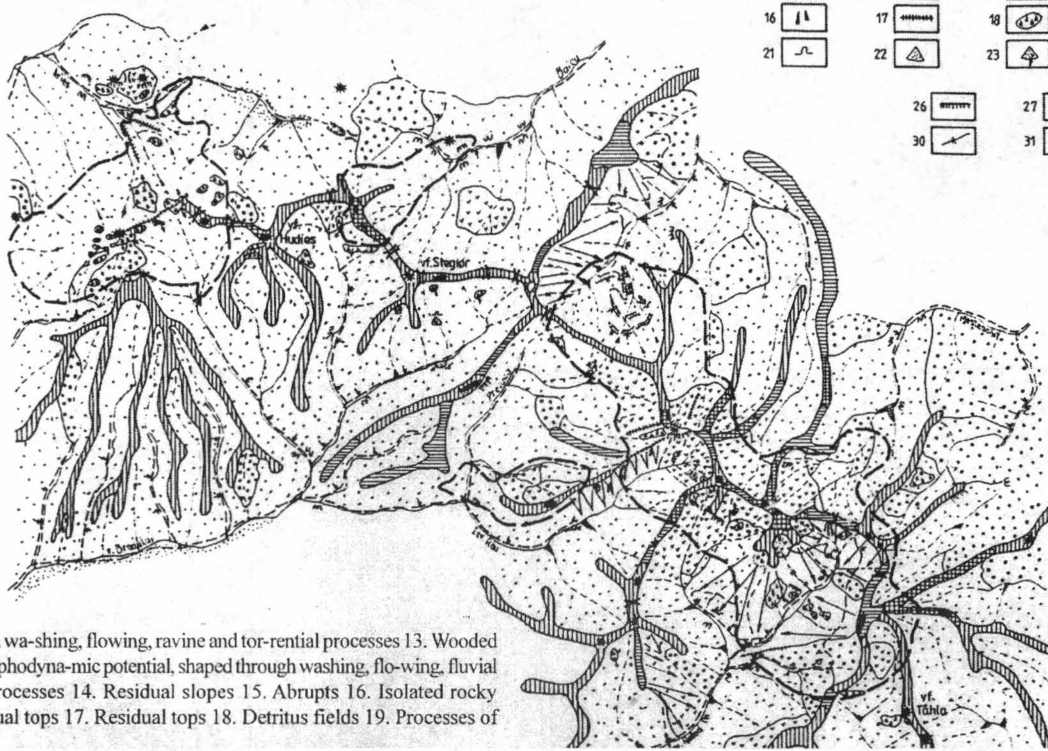
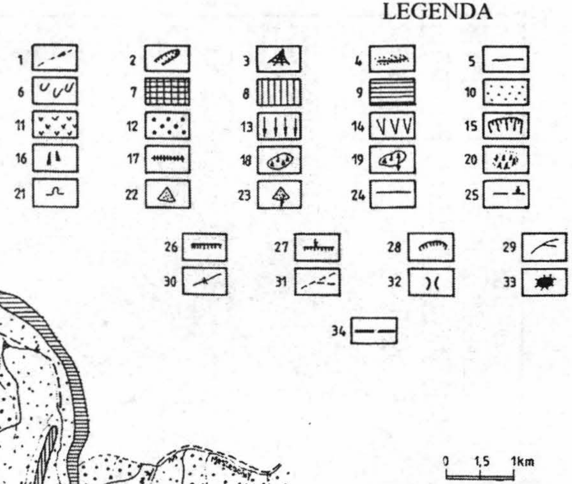
Fig. 1. The map of the current geomorphologic processes and morphodynamic potential within the Țibleș massif





1. Fluvial and nivo-tor-ential rocesses 2. Ditches, ravines 3. Over-flowing cones 4. Meadow 5. Unstable river beds 6. Super-ficial nad-slides 7. Inter-fluvial surfaces with a high morphodynamic po-tential 8. Inter-fluvial surfaces with a mo-derate morphody-na-mic potential 9. Inter-fluvial surfaces with a low morphodyna-mic potential 10. Wooden slopes, mor-phodynamic stable 11. Slopes covered by sub-alpine pas-tures, shaped through complex processes 12. Cleared slopes, mostly shaped through wa-shing, flowing, ravine and tor-rential processes 13. Wooded slopes, with a high morphodyna-mic potential, shaped through washing, flo-wing, fluvial and nivo-torrential processes 14. Residual slopes 15. Abrupts 16. Isolated rocky formations 17. Residual tops 17. Residual tops 18. Detritus fields 19. Processes of detrius mobilisation 20. Reactivation sector for the detritus coverlet 21. Mine vents 22. Sterile ponds 23. Mobilization processes of the ponds sterile 24. Unpaved mining and forest roads 25. Linear erosion processes along the unpaved roades 26. Anthropogenous abrupts 27. Crumbling and downfall processes on the anthropogenous abrupts 28. Stone-pits 29. Permanent hydrographic network 30. Waterfalls 31. Temporary hydrographic network 32. Ensaddlements 33. Pointed peaks 34. The limit of the magmatic bodies

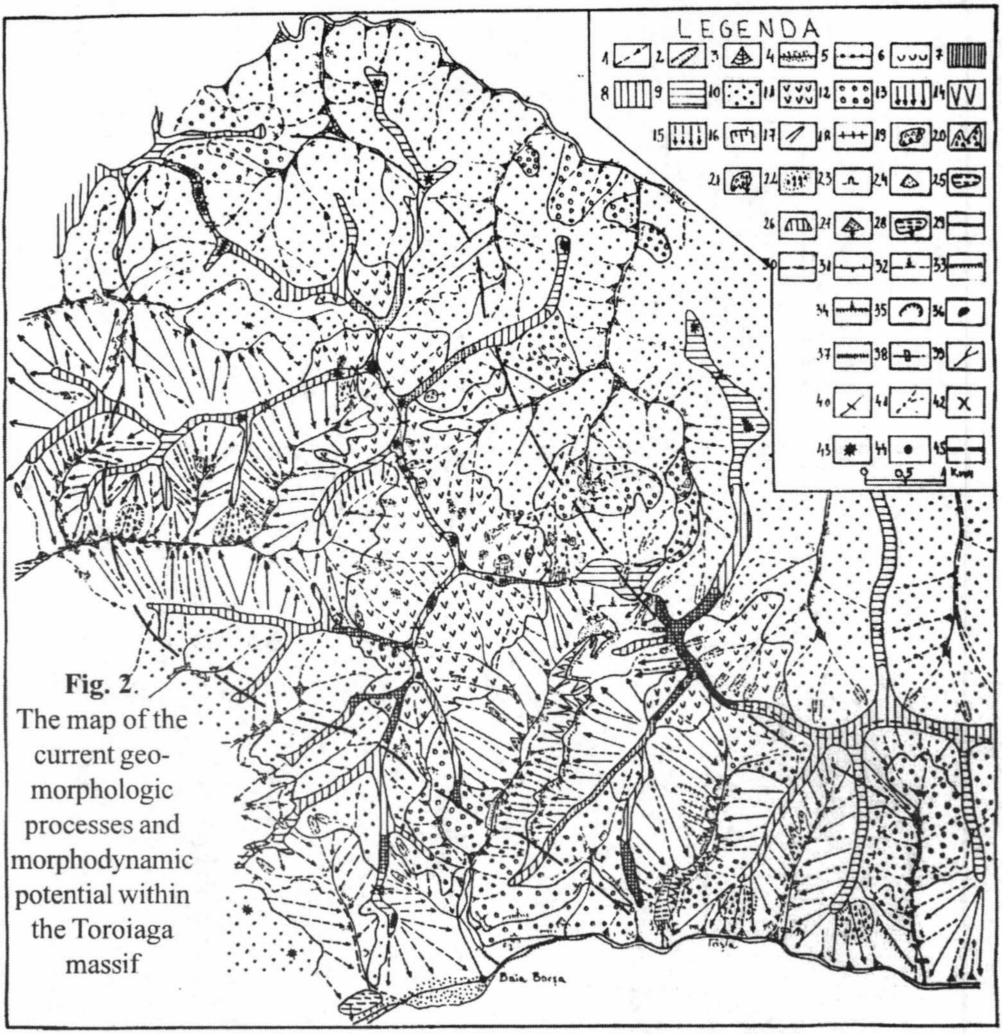


Fig. 2. The map of the current geo-morphologic processes and morphodynamic potential within the Toroiaga massif

I.Fluvial and nivo-torential processes 2. Ditches, ravines 3. Recent overflowing cones 4. Meadow 5. Unstable river beds 6. Superficial landslides 7. Inter-fluvial surfaces with a high morphodynamic potential 8. Inter-fluvial surfaces with a moderate morphodynamic potential 9. Inter-fluvial surfaces with a low morphodynamic potential 10. Wooded slopes, morphodynamicly stable 11. Wooded slopes, with a high morphodynamic potential, shaped through washing, flowing, fluvial and nivo-torrential processes 12. Cleared slopes, mostly shaped through washing, flowing, ravine and torrential processes 13. Slopes covered by sub-alpine pastures, shaped through complex processes 14. Steep slopes, of a batter type, mostly shaped through washing, flowing, rolling and crumbling processes 15. Slopes covered by hayfields, shaped through washing, flowing and biogenous settling 16. Abrupts 17. Dingles 18. Residual tops 19. Detritus fields 20. Detritus trains 21Processes of detritus mobilization 22. Reactivation sector for the detritus coverlet 23. Mine vents 24. Sterile ponds 25. Decantation ponds 26. Dam of the decantation pond 27. Mobilization processes of the ponds sterile 28. Mobilization processes of the decantation ponds sterile 29. Paved roads of local interest 30. Unpaved mining and forest roads 31. Forest railroad 32. Linear erosion processes along the unpaved roads 33. Anthropogenous abrupts 34. Crumbling and downfall processes on the anthropogenous abrupts 35. Stone-pits 36. Lake formed behind a sterile pond 37. Sewered river sector 38. Dams 39. Permanent hydrographic network 40. Waterfalls 41. Temporary hydrographic network 42. Ensaddlements 43. Pointed peaks 44. Localities 45. The limit of the magmatic body

Studii şi cercetări, Geologie-Geografie 10, 2005, Bistriţa, p. 103-112

SUBSTRATUM AND LANDSCAPES

I. RUS[1]

Abstract. Starting from the new directions in the evolution of the geographic science, in general, and of the landscape researches, in particular, in this paper we considered as opportune an GIS approach based on some conceptual trends that will be discussed below.
Key words: ladscapes, GIS

In order to elucidate the relations of spatial and functional determination induced in the landscape by the substratum elements, we considered as necessary to determine the elementary landscape units starting just from the data regarding the substratum, the soils and the land use, the three aspects being strong related. Three main categories of data were taken into consideration: the petrographical characteristics of the studied territory, the soils and the land use features. The logic argument that led us to this option is first of all related to the (temporal) stability of these elements (especially the first too ones), as well as to the catenation conditions (Mac, 1993, Mac and Zemianschi Sanda, 1995) that these elements create when they „project" the elementary landscape units.

Christian and Steward that define the elementary landscape units as phisionomical and functional homogeneous land units analyzed the arguments of this kind of approach in 1953. We consider that the petrography-soil-land use intrinsic information conditions the elementary landscape units (the smallest areas with the same layer characteristics, overposed on only one pedological characteristic, respectively on only one petrographic feature).

The concatenation of these attributes on a before settled level of generalization, allowed us to identify the elementary landscape units. This procedure was inspired by reading the paper „An Analysis of the Geographic Landscapes in the Western Part of the TransylvanianPlain" Ed. P.U.C. 2003, (W.E. Schreiber, L. Drăguţ, T.C. Man), with the specification that the attributes taken into discussion in our case are the above mentioned ones.

The landscape metrics has been a constant preoccupation of the geographers during the last years. With all these, they have not reached an infallible model of approach and this because there still remain some problems to be elucidated as the classification system, especially the scale and the resolution to be used, the types of territory in which to be located the test-areas: hills, plains, mountains, rural, urban etc. This fact and not only explains the cautiousness we have adopted when choosing the attributes (petrography-soil-land use).

These elements condition the particular spatial composition and configuration (diversity, homogeneity-heterogeneity, fragmentation etc.) of the landscape in the Pădurea Craiului Mountains.

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The phases preliminary to the determining of the elementary landscape units implied a set of processes that will be briefly described below.

The first attribute, the petrography, was determined using the geologic map that was processed through petrographic generalization. Our approach was influenced by the fact that the geologic map contained too many classes (38), and, on the other side, we considered that the stratigraphic argument was less relevant than the geochemical and petrographical one (which is our case). Through generalization, 5 petrographic macrocategories resulted, being defined as follows:

P1 – gravels and sands, clays, titian clays, sandy clays, sands, conglomerates, sandstones, marls and, here and there, transition limestones (age interval: Neogene-Quaternary);

P2 – conglomerates, limestones with rudists (the Gossau facies), clayey and calcareous schists, spatic and oolitic limestones (Jurassian), black limestones and red clayey schists, massive limestones and dolomites, marl-limestones and clayey schists (from Triassic);

P3 – conglomerates, sandstones, clayey schists and dolomites in plates (dating from the Lower Triassic), conglomerated breccias and clayey schists (Permian), the Arada series (Paleozoic, Antecarboniferous);

P4 – diorites, granites, granodiorites, porphyritic granodiorites, rhyolites and dacites, tuffs, volcanic breccias and volcanogene-sedimentary marls (magmatic rocks in general);

P5 – Sericite-chloritic schists, micaschists and paragneisses with granate and staurolite, amphiboles and green tuff rocks;

The regrouping on the 5 categories took into consideration, on the one hand, the major petrographico-genetical differentiations (sedimentary, magmatovolcanic and metamorphical), and on the other hand, the differences appearing in the main genetic groups (limestones or dolomites).

The soil is the second element considered in the approach of the relation between the substratum and the geographic landscape using the GRID analysis. The data were provided through the pedological generalization of the soils map, the results being then updated according to the new nomenclature of soils classification. 22 groups were identified.

The significance of the soil categories separated in order to elaborate the GRID analysis is as follows: S1 – eutric aluvisoil, S2 – enthic aluvisoil, S3 – gleyc aluvisoil, S4 – typical eutricambosoil, S5 – undifferentiated eutricambosoil, S6 – eutricambosoil with calcitic xenoblasts, S7 – stagnic eutricambosoil, S8 – rhodic eutricambosoil, S9 – rhodic eutricambosoil with xenoblasts, S10, S11 – eutricambosol, S12 – stagnic luvosoil, S13, S14 – typical luvosoil, S15, S16 – albic luvosoil, S17 – lytic prepodsol, S18, S19 – luvic stagnosoil, S20 – argic erodosoil, S21 – eutric gleysoil, S22 – districambosoil.

The third element considered in the GRID analysis is the land use. This aspect has a considerable importance, because it takes the role of a synthetical attribute in defining the rapport between the geographical landscape and the substratum. At the same time, this element is the most„flexible" (compared to the previous ones). If the ground rock is the most stable element in the landscape construction and the soils are intermediary stable, acting as„buffers" (Mac, Buzila, 2004), then the land use is the most flexible link in the analysis. In order to determine its coordinates, we had to correlate the satellite data (ASTER NDVT etc.) with the vegetation map, with silvical and cadastral maps, as well as with the CORINELC database. As a result of the processing of these data, 21 categories of land use were identified: U1 – Agricultural cultures with annual cycle associated to the perennial cultures, U2 – Rock exposed on the surface (nude utilization), U3 – Beaches and sandy areas, U4 – Deciduous Nemoral forests (deciduous temperate), U5 – Mosaic agricultural cultures, U6 – Conifer forests, U7 – Discontinuous industrial urban area, U8 – Landfill (garbage disposal area), U9 – Orchards and fruit trees plantations, U10 – Industrial area, U11 – Marshes spots, U12 – Agricultural cultures area, U13 – Pits and surface mining areas, U14 – Blended forests with conifers and deciduous trees, U15 – Natural lawns, U16 – Unirrigated arable land, U17 – Pastures, U18 – Copses with trees and shrubs, U19 – Vineyards, U12 – Lakes and ponds, U21 – Water courses.

Through the combination of the above-mentioned indicators (petrography, soils and land use), each of them with the established number of classes, and with the help of the UNION function, 3852 of combinations resulted. These combinations represents the elementary landscape units, meaning the smallest areas in which an only one type of layer is overposed on an only one characteristic of the substratum. We identified the elementary landscape units, but, further on, their processing and management (in order to determinate other superior entities) become rather difficult because of their large number. In this respect, we will reconsider them at the qualitative level and fuse the ones presenting the same substratum, soil and land use features. Thus, reordering the 3852 elementary units, a new structure of 433 qualitatively agglutinated groups will come out.

The qualitative and quantitative characteristics of the matrices of the (focusing on the substratum-rock-relief function) geolandscapes in the Pădurea Craiului Mountains will be exposed below, in a synthetic form (through applying the surface ranking principle), with 6 geolandscape categories as follows:

Gl category geolandscapes – resulted through grouping the elementary landscape units with a surface between 5600-3600 ha;

G2 category geolandscapes – resulted through grouping the elementary landscape units with a surface between 1700-1000 ha;

G3 category geolandscapes – resulted through grouping the elementary landscape units with a surface between 1000-700 ha;

G4 category geolandscapes – resulted through grouping the elementary landscape units with a surface between 700-400 ha;

G5 category geolandscapes – resulted through grouping the elementary landscape units with a surface between 400-200 ha;

G6 category geolandscapes – resulted through grouping the elementary landscape units with a surface under 200 ha;

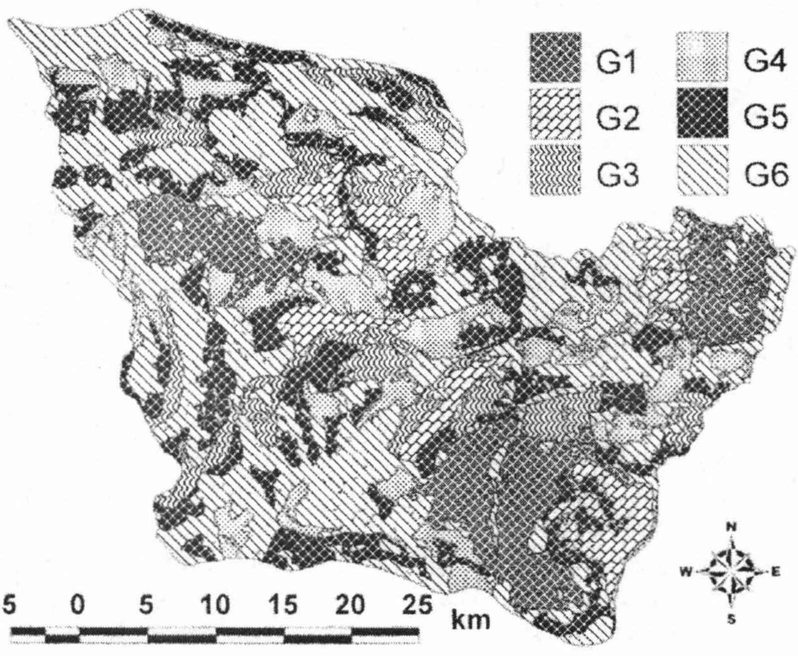
The geolandscapes in the Gl category represent, as regarding their territorial extension, around 11.67% (more precisely 17.878,18 ha from the total amount of 153.115,47 ha) from the studied area. The spatial distribution is illustrated by the Fig. 1, the geolandscapes being located in the middle and upper sector of the Topa River (Northward the settlement of Corbeşti), respectively in the upper section of the Iada Valley.

The extension of the surfaces occupied with the Gl geolandscapes is evidently related to the slope processes, because the determined fields have a symmetrical or qvasisymmetrical character to the valleys that cross them (Topa, Iada or Neportoc River).

As regarding the petrographical aspect, it is evident the dominance of the P4, respectively P5 categories (with some exceptions, see P2), that is that of the magmatic and metamorphic rocks, fact which rise the idea that the metamorphic and magmatic substratum generates well individualized and relatively compact landscapes as compared to the sedimentary one.

From the pedological point of view, the dominant category is the S22 (districambosoils), followed by the S4 one (typical eutricambosoils).

Fig. 1. Geolandscapes in the Pădurea Craiului Mountains



A very interesting fact is to be noticed in the case of the Gl class, that is the absence of the human settlements in spite of the existent water sources that would allow them. This aspect could be explained by the morphometric characteristics of the area and by the qualitative parameters of the soil.

Another feature of this class is the increased vertical fragmentation (200-400m), as well as the fragmentation density, which is average to high (2-3,5km/kmp). The slopes are featured by energic values over 17°, sometimes reaching the extreme value of 62°, this indicator contributing to the spectacular landscapes common to the high mountains, even if in reality the Pădurea Craiului are considered low mountains.

The transversal profile curvature is characterized by standard deviations of high amplitudes with well-individualized areas of erosion and accumulation. This fact correlated to the slope situation and to the qualitative soil parameters partially explains the lack in the necessary conditions for the human settlements installation.

Another important feature of this geocategory is the well representation of the permanent hydrographical network, which implies a continuous mass evacuation. As regarding the land use, this category is also well individualized, the U4 indicator (temperate nemoral forests with deciduous trees) being almost exclusive. This geocategory has the largest territorial extension, being strongly differentiated by the dimensions of the other elementary units, and this fact could be causally explained only through the correlation with the quality of the P4, respectively P5 indicators. In this way, from values of the elementary units surfaces of 5.600-3.600 ha, corresponding to the G1 geoclass, it can be noticed a hiatus to values of 1700 ha, and then an almost linear decrease of the surfaces of the elementary units categories.

The geolandscapes in the G2 category, resulted by adding the elementary landscape units with a surface between 1700-1000 ha, represent 7,31% from the total surface that is around 11.204,76 ha. The following groups were identified: in the central Southeastern part of the studied territory, following in some way the alignment that links the Vacariste Hill, the Acru Hill and the Dosului Hillock; in the central part, a group formed by the Stalpului Hill, the Scaunul Craiului Summit and the Merişorului Peak; to the center North, the groups in the Tomnatec area and the Crucii Hill. Other two groups were identified, one in the Bulz area, and another in Poiana Runcului area and Molivisu, but these are only contiguous units and that is why we gave less importance to them.

Similar to the Gl category, the G2 also include areas with relatively compact aspect. As concerning the petrography, the G2 geocategory is characterized by the dominance of the P2 indicator, in other words we deal with a substratum with conglomerates, sandstones and limestones. The relevant pedologic participation is of P8, respectively P4 type, meaning the rhodic and the typical eutricambosoil. The values of the fragmentation density lie between 0,5-2, maximum 3 km/kmp, while the vertical fragmentation is of 220-330 m.

From the hydrographical point of view, this category is characterized by the lack of the permanent hydrographical network, which implies a dynamic inhibition. The cause of this inhibition can be found in the petrographical composition (P2, conglomerates, limestones etc.).

If analyzing the land use character, we could not make an immediate association because of the existent large variety. The specific land use categories are the U4, U14, U6 and U12 (nemoral forests, blended conifer and deciduous forests, conifer forests, agricultural cultures). This situation is explained by the relief features and by the run-off characteristics and less by the substratum composition.

As regarding the habitats, the central Northern sectors are characterized by dissipated houses, while the central Southern areas are completely unpopulated. This is a possible consequence of the substratum (with conglomerates and limestones), which induces a deficitary hydric regime and a relatively lack of water in the central Southern parts.

The G3 category of geolandscapes, resulted as a fusing of the elementary landscape units with a surface between 1000-700 ha, has a spatial distribution illustrated in Fig. 1, lying on 7,89% from the total surface or 12.090,55 ha. As compared to the previous categories (Gl and G2), the G3 spatial extension is completely different, the fields don't have a compact character, but an ordering on two almost parallel alignments disposed from East to West is registered. From the petrographical point of view, the G3 category is characterized by an almost exclusively sedimentary bedrock (PI, P2, P3), but with different and heterogeneous characteristics and facieses (conglomerates, sandstones, limestones, clays etc.).

The soil is slightly different from the previous groups, beside the districambosoil and the typical eutricambosoil here being also present in a considerable proportion the gleyc aluvisoil (S3). A direct link between the fragmentations situation and the spatial distribution of this geocategory was identified. In return, a mimetism of the G3 distribution m relation to the old terraces was noticed in many cases.

This group of geolandscapes can be considered as the periurban one, because its terntonal extension is usually contiguous to the inhabited as ess This thing is also reflected in the land use features (U4, U5 and U12) different from the previous categories because of the appearance, beside the nemoral deciduous forests, of a mosaic of cultures or of homogeneous cultures.

The geolandscapes in the G4 category resulted through the agglutination of the elementary landscape units with surfaces between 700-400 ha. Its surface is of 12,34% from the total, more precisely of 18.904,43 ha. If referring to the diversity, this category is the most varied one as compared to the others.

As concerning the spatial distribution, no rule was identified in the disposal of the corresponding areas, the discrete aspects of the phenomena that could not have been revealed through the here used methodology are to be taken into consideration further on. This fact confirms the hypothesis of the geographic systems non-linear evolution.

Petrographically speaking, the G4 substratum is almost exclusively sedimentary (P1, P2, P3) and very similar, as referring to its characteristics, to the typical exokarstic areas. The types of soil are extremely numerous and diverse.

The characteristic land use classes are also varied: U4, U5, U12, U14 (different forests and different cultures). A causal relation between the areals of this category and the fragmentation parameters could not be enlightened.

As regarding the hydrography, the G5 category is characterized by permanent, temporary and blind valleys.

The inhabited areas don't have a preferential regime within this category, unpopulated territories being also included. The behavior of this category is preferably aleatoric, the agglutination of the constitutive elements being probably done on discrete aspects (the pH, the erosion level etc.).

The G5 geolandscapes category resulted through the fusion of the elementary surfaces of 400-200 ha. The result was a composite area of 25.875,08 ha, that is 16,89% from the total considered surface. The large number of the elementary classes transforms this category into a very diverse one.

As referring to the petrographical aspect, the relevant participation is given by the P1, P2 and P3 indicators, as we deal with an almost exclusively sedimentary substratum. The pedologic structure is very diverse, almost all the identified types of soil being present here.

Because of the high diversity and of the large territorial distribution, the filiation of this geolandscapes group was difficult to be determined.

However, an attentive analysis could give us evidence on the link between this category and the horizontal fragmentation.

A spatial distribution of the G5 areals in direct proportion to the horizontal fragmentation values and to the permeability was noticed.

The land use is illustrated by very different indexes, in relation to the above-mentioned diversity.

The G6 landscape category represents the agglutination of the smallest elementary areas (under 200 ha), having the highest diversity of the six groups. Spatially speaking, it lies on 43,86% from the total surface, that is 67.162,47 ha.

The bedrock of this group is almost exclusively sedimentary. The soil composition is very heterogeneous, almost all the identified soil types appearing here.

The territorial extension of the G6 category is strongly related to the horizontal fragmentation indicator.

The G6 group is present everywhere the values of the horizontal fragmentation are higher than 1,5 km/kmp.

As concerning the inhabited areas, we can affirm that the G6 category is the cradle of the settlements.

The landscape of the mountainous boundary is marked out by abrupts with a very active clinotropic dynamics (landfalls, land collapses, torrential erosion, gorge selective modeling etc.). On such a petrographic and morphologic support, the vegetation was significantly changed, the compact forests being replaced by the shrub vegetation or by other components. Some small landscape units with strong human interventions (bauxite and limestones exploitations etc.) are located here.

The submontane landscape, with a hilly aspect, is also characterized by important human interventions (inhabitation, land use, agricultural cultures, infrastructure etc.). This landscape will be gradually replaced by a hilly one developed on glacises, which marks out the transition to the Western Plain.

The transition landscapes (with strong interferences) are defined by the alternation between the depression basinets and the low hills, which offer them the character of the western piedmonts, a slighter correspondent of the ones in the Western Apuseni Mountains (Zarand and Codru – Moma, for example). While in the depression gulfs the characteristic geofacieses are those of valley and little inclined slopes with active geomorphologic processes (landslides, torrential erosion), to the "promontories" (meaning the low and long mountainous summits) the existing forest vegetation was partially preserved and here and there replaced by cultures, pastures or hayfields etc.

A specific feature of this geographic space is the presence of the directly determined landscapes, the exokarstic ones. The areas they lie on depend on the characteristics of the karst in the substratum. An example is the landscape of the dolinar karstic valleys in which the remarkably thick superficial deposits came down from the slopes are extremely well preserved, being able to host in this way various human activities. Here and there, the various dolines or other exokarstic manifestations (lapies fields etc.) catch one's attention.

The valley landscape, formed through tectonical processes (of graben or fault type) or through hydrographical erosion, is a very remarkable one.

A significant difference is noticed between the landscape of the deep valleys with steep slopes, long channels and narrow terraces (see the Iada Valley in the upper and upper-middle sector) and that of the valleys developed on sedimentary substratum, with large catching basins and attenuated transversal profiles. Small human made landscapes in disequilibrium state are also significant (pits, waste dumps etc.). We didn't focus our attention on this group of landscapes, because we followed with predilection the "substratum-landscape" relation, faithfully expressed in the exposed landscape valences which were used in the working out of the landscape typology as a conclusion of our researches.

As the temporal and spatial evolution of the landscapes in the Pădurea Craiului Mountains is concerned, we deal with a triple situation:

– Landscape in biostasie, in equilibrium to the climax state (high plateaux landscapes);

– Landscapes in rhexistasie (as a result of the brutal interventions in the territorial structures);

– Landscapes in parastasie, maintained by the human activities (spruce fir nurseries, for example), one of them being in advanced parastasie, with features of relative biostasie.

At the same time, the G6 group is the host of the exokarstic processes, especially of less extended spatial forms (microdolines, dolines etc.).

Conclusions and final observations

The elaboration of this paper followed all the time the determination logics, which focused the „message" of the substratum to the surface components (water, topoclimate, vegetation, fauna, human components), as well as on the contrary way of the transformations suffered by the bedrock under the exogene influences.

At the second turn, we admit that we have pre-eminently treated the geographical analysis (no matter if componential or territorial); in fact, the analysis and the synthesis were braided at any level. For example, the soil was, on a first level, analytically analyzed, but, at the same time, it was also assessed in accordance with the rock provided by the substratum and with the biotic components that influence its evolution.

From the instrumental point of view, we used modern GIS techniques (ASTER and LANDSAT TM+ satellite images. Radar satellite images etc., which were processed through various softs as Arc View 3.2, Erdas Imagine 8.6, DiGem, Saga, Microdem 7.1, Global Mapper 6.1) that helped us very much in the various steps of the elaboration of this present paper.

The qualitative and quantitative aspects, the various typical and atypical indicators, the complex profiles were obtained only with the help of this technical basis. At the same time, we could point out the territorial units in relation to an element or another, to the existing correlations (substratum-soil, soil-vegetation, relief-vegetation etc.), all these elements contributing to the major purpose of the landscape units delineation based on the triple connection between substratum (rock-relief) – soil – land use.

The identified land units as functional scalar structures express in an accurate way the rapport between the above mentioned components.

When dealing with the spatial, structural and functional differentiation, we took into consideration various criteria, which led us to the idea that the Pădurea Craiului Mountains constitute a distinct territory within the Apuseni Mountains. The landscape here is an evident expression of the above mentioned orogenetic features, which were nor of high or low mountains, but with significant transition to the adjacent units (direct transition through abrupts, gradual transition through contact glacises with a specific landscape and interfering transition in the case of the depression gulfs (creeks) or of the promontories gradually decreasing in height to the west).

The elaboration of a landscape typology was possible by using as a criterion the biotic or human factor.

As an example for the first case is the vegetation, as the forest landscape with its shades; as regarding the second case we can take as an example the various agricultural landscapes (arable land, hayfields etc.) or the semi-industrial and mining landscape (refractory clays exploitation pits, surface mining activities etc.).

We consider useful in our case the working out of a typology that takes into account the altitude, the orientation in the topographical sense and the forms in which the considered components are spatially associated.

As a result, we could consider the landscape of the high plateaux or of the high summits developed on calcareous substratum, which are characterized by well-developed forestry vegetation.

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Studii şi cercetări, Geologie-Geografie 10, 2005, Bistriţa, p. 113-122

SOILS AND EPIHYDROGRAPHIC PARTICULARITIES, LANDSCAPES GENERATORS IN THE PĂDUREA CRAIULUI MOUNTAINS

(PART I)

I. Rus[1]

Abstract. *The Pădurea Craiului Mountains are situated in the Northwestern part of the Apuseni Mountains, where they are individualized as a distinct unit. They are detached from the „central block of the Apuseni" on the line of the Remeţi graben. The soils in the Pădurea Craiului Mountains represent a geographic synthesis of the relations between the abiotic, biotic and even autotrophic components of the geographic territorial system, they determining the installing of the geographic landscape as a superior entity within the geospatial and temporal integration. Although they are products of some past geographic states (especially from the Quaternary, or more precise from the Holocene), they can constitute the base for the „projection" of new states and structures. The natural evolution of the soil as well as the human intervention contributes to the delineation of this role.*
The hydrographic network of the Pădurea Craiului Mountains is tributary to the Crişului Negru River (at South and South-east) and to the Crişului Repede River to the North.
Keywords: *soils, hydrological network, landscapes*

1. Gnoseologic framework and approaching principles

Starting from the new directions in the evolution of the geographic science, in general, and of the landscape researches, in particular, in this paper we considered as opportune an approach based on some conceptual trends that will be discussed below. For the beginning, we presented the scientific content of the literature used in the landscape knowledge.

In this regard, it was compulsory to refine the major themes in the landscapes knowledge in order to be able to choose a certain framework or direction and to create a conceptual premises necessary in the paper elaboration. Thus, we focussed on the following gnoseologic states:

– The thinking of the landscape as an image of the places (which corresponds to the beginning of our knowledge field). But the image of the places was assumed by various persons and transformed in the subject of their preoccupations, in various senses (from painters to writers and even geographers), the landscape trend being preserved to nowadays, somehow different to the science we deal with.

– We then detected a second form of approaching, when the landscape becomes an object of the geographical knowledge as a contribution of some famous geographers (Passarge, Humbold, Troll etc.). This kind of approach, even if starting in two directions,

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from outside (imagistic) and from inside (analytic), it remains rather arbitrary, in the sense that, what was focussed from inside wasn't the landscape properly, but the relief, substratum, water, living components etc.

– A crucial moment in the approaching way follows, in which the landscape as territorial reality becomes itself an object. Its knowledge required the analysis of its configuration, of its image, but also of its own structure with cell units (organic).

As a consequence, the landscape becomes a structured territorial reality with well-defined functionality. It is thought as an expression of a high geographical integration of the components it consists of, but which imposes itself through its own identity.

Correlated to this phase and starting from the first approach, the landscape typology appears as inherent, being based on some criteria as the geo-spatial and functional features of the landscape. In the first phase, the landscape typology uses individual criteria (for example mountain landscape, seaside landscape, fito-geographic landscape, agricultural landscape etc.).

Only to the end of this period the typology takes into consideration the landscape dynamics, its effective states (landscape in equilibrium, landscape in decline), but with ecologic connotations.

The progress in some various fields of the scientific knowledge and especially in the fields tangent to geography (ecology), determined a junction between the preoccupations of the landscape researchers and those of the ecologists. It isn't circumstantial the shaping of the geo-ecological thought and the interpretation of the landscape in this direction (Troll). This way of approaching led to an unpleasant situation too, which is the confusing of the landscape units with the ecosystems. At the same way, some of the geographers keep referring to the interpretation of the landscape in a bio-geographic manner (Bertrand), forgetting that there are regions (or areas) in the world in which the vegetal component is insignificant (desert regions, polar regions etc.).

At a certain moment, this trend was considered to be extremely useful in the landscape knowledge. But subsequently papers appeared and proved that landscape knowledge should follow some principles among which it is worth mentioning:

– The landscape domain surpasses that of the ecosystems. In this respect, we could mention the contemporary Russian School in which the superior rank landscape units include various ecosystems; The correlation principle should be used in the landscape knowledge, in the sense that many and various relations are involved (geologic, ecologic, agro-systemic), but the landscape can not be transformed in something else but what it really is;

– The principle of the determinant factor was and should be still used in the landscape assessment, and in this respect, the various approaching ways should be understood. We took into consideration such a determinant factor and we concluded that this factor (no matter if unique or complex) should be the base of the interpretations. We appreciate as useful the considering as determinant factor of the land-use forms (as it was used by the Australian school, the results being those „land units"), but the rising question is how could we apply this principle to territories not used by men?;

At last, we focussed on the methodological aspect through which the landscape was considered as a multitude of territorial units of various sizes and its knowledge would imply only the exploring of this spectral „mosaic" in a given area. We based our study on this approaching manner, but we bring the logic observation that we cannot substitute the way of presenting the object (the landscape) with the object itself. We considered as normal the existence of a spatial diversity of micro-, mezo-, macro-units in the areas where the factors of support and construction can be characterized in the same manner. As a consequence, we kept using the collocation „unity in diversity". As a prove, we identified big landscape units correlated to some lithological features and we noticed an increase in the dividing when passing from the rock body to the superficial deposits where the mineralogical aspect grew in importance.

The principle of diversity in the landscape research, when applied correctly, leads to a major idea, which is that of understanding and knowing the landscape through the concept of relation. The relation was thought within a large systemic context and it is based on:

– Mass, energy and information exchange, in the sense that the landscape, functioning as a geographic entity with synergic construction, the substance coming from all the possible supports, but at least from two directions: from the telluric components and from the cosmic components. In this way, the transition from the rock to the mineral and to the circulation of substance in the vegetal mass interfered with processes as the photosynthesis and the physical and chemical weathering determined by the action of the solar energy; the two directions, through substance inputs, are mirrored in the landscape under the energetic impulses. We should emphasize that it is not only about pure, incidental energy, but also about the discrete energy. For example, the thermo-energetic behaviour of the rocks (see the limestones which during some processes of chemical weathering generate exothermic reactions releasing energy, see other rocks and the rapport between the leucocratic minerals versus the melanocrat ones and their photo- and chemo-thermic behaviour, etc.). On the other hand, it is evident that the energy came from the geolandscape to the substratum too, meaning that through the processes having place at the topographic surface, the petrographic bed suffered changes (physical and chemical weathering). Within this context, the information had a triple role: of intrinsic information which manifests at the level of a geolandscape unit, of extrinsic information which enlights what happens at the level of the whole territory and which have repercussions on the intimate landscape states from an unit to another, and at last, large comprising information (climatic information, paleogeographic information) which will constitute the support in understanding the paleoland scape.

– The mutual adjustments which take place within the landscape entity or within its subunits and/or between the landscape in its whole and its supports, meaning positive and negative feed-backs.

Through these mechanisms, there were and there are noticed increasing states in the evolution of the landscape, or, on the contrary, the preservation of some conservative states by adjusting the response factors.

In this way, the development of a mature soil layer with a certain thickness could maintain, as it acts as a buffer-filter, an equilibrium state of the landscape for a long time (as it can be noticed in the central part of the studied area, characterised by states of climax, even if analysed from the point of view of the previous theories).

The selectivity was applied using the above-mentioned principles and not only. Thereby, the type of our research, which is a relational one (between the substratum and the landscape) and the performed analyses, determined us to select three fundamental defining components: the substratum, understood as the totality of the petrographical and tectonical elements and their corresponding landforms, the soil as an expression of the pedogenetical factors (that which, beside the substratum, is implied by the meteo-climatical and biogeographical processes etc.) and the land use, as a consequence of the human utilization. A geographic complementarity resulted in this way.

The landscape is thus a consequence of the geospatial complementarity through the mobilization and response factors. Therefore, we can define the landscape as the superior form of geographic existence in a given territory, a product of the integration of the sustaining factors with those of transformation. It is a territorial expression, as regarding both its shape and content.

The manner of knowing this territorial reality, of maximum synthesis, followed thus the factorial and the relational analysis, the geographic synthesis and the concrete territorial expression (the landscape itself).

3. The Pădurea Craiului Mountains, geographical location and spatial relations

The Pădurea Craiului Mountains are situated in the Northwestern part of the Apuseni Mountains, where they are individualized as a distinct unit. They are detached from the „central block of the Apuseni" on the line of the Remeți graben.

As regarding the borders, the individualization of the Pădurea Craiului Mountains takes various aspects. To the Eastern part, almost all of the researchers that studied here agree that the limit is the Iada Valley, which presents a complete superposition to the Remeți graben. Even if from the petrographical point of view the Iada Valley crosses four different sectors, it is the only major morphological element to be taken into consideration.

To the northern part of the Pădurea Craiului massif, between Bulz and Vadu Crişului, the limit coincides to the Crişul Repede River and forward to the line of glacises between the settlements of Birtin and Butan. From Butan to the Subpiatra settlement, the Northwestern border is more evident, being represented by a limestone abrupt. The Northern limit separates the mountains from the Neogene sedimentary basin of Vad – Borod.

To the Western and Southwestern part, the limit is difficult to be established because of the complex interferences, it being not obvious and presenting a pinked and sinuous character. The border may be related to the localities of Subpiatra, Dobres.ti and Meziad, which seem to follow a contact alignment. This line usually separates the Codru formations, overthrusted on the Bihor Unit, from the Neogene formations specific to the Beius Depression and to the Holodului and Taşadului Hills. A limit of the landscape could also be delineated, between that with human dominance and that preserved on natural bases.

To Southeast, starting from Meziad, the limit is represented by the interfluve of the Meziadului and Luncilor Valleys up to the morphologic eruptive upstream the Iada Valley.

4. The Pădurea Craiului Mountains soils

The soils represent not only a sum but a result of the synergic evolution of the rocks in the substratum, of the superficial deposits, of water, of vegetation etc, under the guiding influence of the climate, in general, and of the topoclimate, in particular.

The soils in the Pădurea Craiului Mountains represent a geographic synthesis of the relations between the abiotic, biotic and even autotrophic components of the geographic territorial system, they determining the installing of the geographic landscape as a superior entity within the geospatial and temporal integration.

The landscape being installed, the soils still keep their „buffer" function (I. Mac, L. Buzilă, 2004 in press) between the metamorphoses taking place in the epigeosystem with an important role in maintaining a general dynamic equilibrium of the studied territory.

Although they are products of some past geographic states (especially from the Quaternary, or more precise from the Holocene), they can constitute the base for the „projection" of new states and structures. The natural evolution of the soil as well as the human intervention contributes to the delineation of this role.

At the same way, the soils become important providers with direct information on the geographic landscape quality. For example, the predominance of the percolation regime is enlighted by the abundance of the luvisoils, while the presence of the rendzine and the insular areas with eutricambosol rodic reveals a particular structure of the geologic substratum: with limestones and dolomits.

As regarding the systematic features, the following types of soil were found in the Pădurea Craiului Mountains:

The cernisoils class

The rendzines

They appear in the North-Western and Central-Eastern sector, being usually superposed over a bedrock with limestones and dolomits, dating from the Lower Jurassic (in the central-eastern sector) and from the Medium and Upper Jurassic (in the North-Western sector), together with Pre-Gossau Cretaceous formations (limestones with characins, bauxites, limestones with gastropods etc.), all of them belonging to the Bihor Unit.

The rendzines in the analysed area are characterized by the presence of an [Am] horizont of dark colour and it is usually associated to fragmented landforms (narrow summits, steep slopes, breaches etc.). The basis rock horizont of the soil strongly influence the pedogenetic processes, the basic elements of the substratum sustaining the bio-accumulation process. The following subtypes were identified: the limestone rendzine, the cambic rendzine and the skeletal rendzine.

The luvisoils class

The Luvosoil

The luvosoil usually apperas in combination with the eutricambisoil in the central-western and south-western sector on a bedrock with sandstones, quartzite sandstones and clay schists dating from the Medium and Lower Triassic. It was also noticed an areal cohabitation with the preluvosoils on the plane or quasiplane landforms. The formation conditions imply the following aspects: deficitary external drainage, parental rock lacking in basic elements, more humid and cool climate (cf. Groza I., 1999).

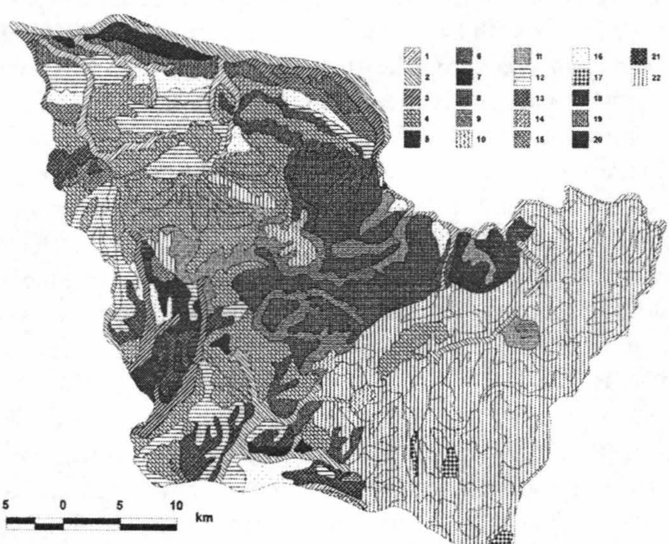
In the central-western sector, the luvosoils constitute a belt which ends at the settlement of Varciorog, having as parental formations Lower Quaternary detritic deposits disposed as a slight inclined plateau. The formation of the luvosoils is related to the specific vegetation (beeches blended with other deciduous trees). Under the treetop of the deciduous forests, an acidophilic herbaceous vegetation develops. Because of the pedogenetic conditions the parental rocks are strongly chemically weathered and debasified, the resulted products being mainly levigated. Among the determined subtypes of luvosoil it is worth mentioning: the lithic luvosoil and stagnic luvosoil.

The lithic luvosoils appears here in association with the eutricambisoils and with the preluvosoils.

The preluvosoil is determined by a percolative hydric regime, which, together with the low temperature, leads to a debasification and to an up or down circulation of the clays in the soil profile.

The more inclined slopes are covered with eutricambisoils, sustained by the presence of the superficial basic rocks, while the less dipped ones with a more intense clay-illuviation facilitate the appearance of the preluvosoils.

Fig. I. Soils of Pădurea Craiului (1 – eutric fluvisol, 2 – entic fluvisol, 3 – gleyc fluvisol, 4 – eutriccambisol, 5 – undiferentiated eutriccambisol, 6 – calcitic xenoblasts eutriccambisol, 7 – stagnagley eutriccambisol, 8 – chromic eutriccambisol, 9 – xenoblasts chromic eutriccambisol, 10, 11 – eutriccambisol, 12 – stagnagley luvisol, 13, 14 – luvisol tipical, 15, 16 – albic luvisol, 17-leptosol, 18, 19 – stagnagley luvisol, 20 – argic erodosol, 21 – eutric gleysol, 22 – districcambisol)



The cambisoils

The eutricambisoils

They are well represented having a standard morphology – Ao, Ao/Bv, Bv, Bv/C, C (R). The moderate acid reaction is between 5,4-6 in the Ao horizon and, in the rest of the profile the reaction being from moderate acid to basic (cf. Piciu T. and Simihaian M, 1999). The humus, especially of mull type, lies between 5,5-12% in the Ao horizon, its value decreasing gradually, at the base of the profile being of 2% (in the Bv horizon).

The rhodic eutricambisoils

These types of soil appears as patches more or less extended in the South-eastern part of the Pădurea Craiului Mountains (the Roşia Depression), in the upper basin of the Vida Valley, in the Vadu- Crişului – Măgeşti sector etc.

Considered by some authors as relict soils or paleosoils, the rhodic eutricambisoils formed under conditions different than the present ones (its profile containing at least a Pleistocene horizon). The specific of these soils is given by the parental base, which contains limestones (of different ages, structures, textures, colours) and bauxite.

The areas where these soils formed are characterized by an annual temperature higher than 9°C, average annual precipitations of at least 700 mm and annual aridity index higher than 35.

The natural vegetation consists of bunches of *Quercus cerris, Q. Farnetto, Q. Robur, Fagus silvatica, Carpinus betulus, Fraxinus excelsior, Cornus mas, Coryllus avelana,* as well as human made pastures with *Andropogon ischaemum, Festuca valesiaca, F. Sulcata.* The characteristic karstic relief is made of less steep slopes, terraces, dolines, etc. In some areas, beside the typical rhodic eutricambosoils, some lithic subtypes also appear.

The districambosoils

They develop under a cool and humid climate, which leads to a reiterated percolative hydric regime. The parental rocks of the districambosoils consist of Permian, Medium and Lower Jurassic formations represented by conglomerates and acid and intermediate sandstones in the Eastern sector corresponding to the Iada Valley. This type of soil also appears in the Central-eastern part on Medium Triassic deposits. The districambosoils facilitate the development of pure or blended beech-trees, as well as that of some acidophilus herbs.

The protisoils class

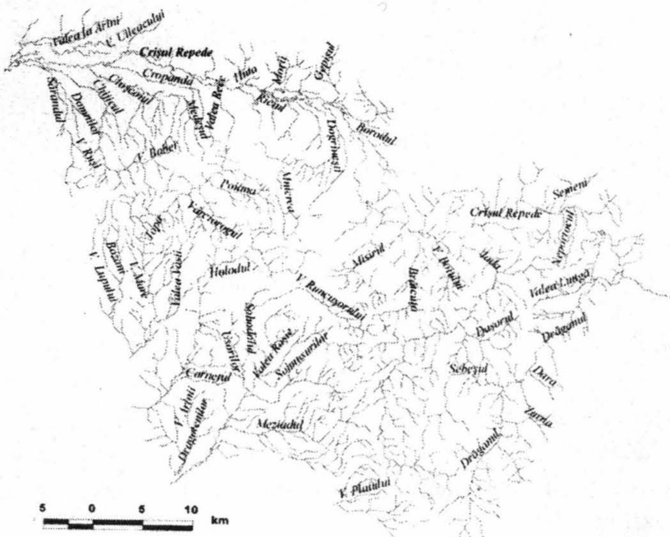
The lithosoils

In the studied area, this type of soil is correlated to the presence of some compact rocks (more or less physically weathered) and to a weak chemical weathering. The organic mass, in various phases of putrefaction, accumulates in an A or O horizon as a consequence of the installing of the cormophite and thalophite vegetation. The so formed profile, very superficial, represents the incipient stage in the evolution of this type of soil. The lithosoils are the best-individualized soils in the Pădurea Craiului Mountains. It should also be mentioned that we could differentiate other soil subtypes too, especially at the transition from one type to another.

5. Epihydrographic particularities

The hydrographic network of the Pădurea Craiului Mountains is tributary to the Crişului Negru River (at South and South-east) and to the Crişului Repede River to the North. The distribution of the tributary rivers in these two main hydrographic basins has the following coordinates: 60% from the surface of the tributaries belongs to the Crişului Negru River while 40% belongs to the Crişului Repede River.

Fig.2. Pădurea Craiului – hydrological network



Among the affluents of the Crişul Repede River, the most important are:

– The **Iada Valley** separating the Pădurea Craiului Mountains from the neighbouring massifs of Bihor and Vlădeasa. The particularity of this valley is given by the run-off regime, four different sectors being noticed as regarding the run-off regime.

– The **Boiului Valley,** flowing into the Crişul Repede River westward the locality of Lorau, has a dendritical development, being characterized by a permanent discharge in the middle and lower sector provided by the karstic sources of DrSgoaia, Buchii and Izvorul Mare.

– The **Brătcuței Valley** has the catching basin developed on crystalline schists, fact which determines permanent dischArgeş. The only important river tributary to the Bratcujei Valley is the Dried Valley (Valea Seaca), which has a temporary character.

– The **Mişidului Valley** is one of the most typical karstic valleys. While in the upper basin the water courses are permanent (being developed on Liassic detritic deposits), in the middle (the Luncilor Valley) and lower sectors, they have an active temporary character, the main collector valley being transformed from a dip and dip valley into a sector with gorges and important alluvial deposits brought here in the flooding periods and then abandoned in the large channel of the valley.

– The **Măguran – Izbândiş Valley** has a less extended catching basin, being almost totally developed on karstic rocks. As compared to the previous, the Măguran – Izbândiş Valley presents some specific features: its upper sector has a dolinar aspect; the valley is deep, temporary in the middle sector and permanent in the lower one. These characteristics were determined by the karst-creation processes and by the major resurgence of Izbandis in the lower sector. The discharge is almost exclusively provided from the underground, the waters coming from rather far karstic depression areas. Downstream Izbandis, the watercourse has a deep enough channel and which also increases in width when entering in a depression flume in which the şuncuius settlement is located.

– The **Sohodolului Valley** is situated to the Northwest of the Măguran – Izbândiş Basin, lying on an intense karstificated area (the Vadului karst). According to Viehmann, Pleşa and Rusu (1964), the dolinar valleys specific to this region constitute the last step in the evolution of the valleys developed on limestone substratum.

Downstream the settlement of Vadu Crişului, The Crişul Repede River collects, westward the locality of Chiştag, some other rivers: the Gălăşenilor Valley, The Mierei Valley, the Chijic River, the Sărand River, the Tăşad River, the Hidişel River etc.

The rivers tributary to the Crişului Negru River belong to three main sectors as regarding the position of their confluence to the major channel: the Beiuşului Depression, the Borz – Şoimi Gorge and the Holodului Depression. In the first sector, the Crişul Negru River catches only the Roşia River, which is one of its major affluents. The hydrographic basin of the Roşia River consists of a large number of tributary rivers, which in the upper sector flow on impermeable deposits (rhiolits, crystalline schists, Liassic detritic deposits etc.), while in the middle and lower sector of the Roşia River some remarkable karstic landforms could be met (The Caves of Ciur – Izbuc, Ciur – Ponor, Meziad, the Stanul Foncii karst-pit, the Lazurilor, Cuților and Albioarei Gorge). In the gorge sector, the valleys are very short and have a torrential character. In the third sector, the Holod River and its tributaries Vida and Topa-râu flow into Crişul Negru. The secondary tributary rivers constitute a temporary radial network crossing the surface of the piedmont hills.

Almost all the main valleys in the Pădurea Craiului Mountains have a sinuous route in the horizontal plane, with a „S" letter development usually implying three segments, an upper one, parallel to the longitudinal axis of the massif; a middle one, directed to North or South; an lower sector, with a contrary direction to the previous one, curving the channels to the west.

The watersheds (both the one between the Crişul Negru River and the Crişul Repede River and the secondary ones) do not always correspond to the highest peaks, they can sometimes avoid some summits or isolated massifs and go down to the karstic depressions through saddles or even by crossing some valleys.

The networks are usually dendritical (excepting the Sohodol and Măgurani-Izbândiş), fact that determines, in case of high intensity precipitations, of long rains, of snow melting, an increase in the discharge, which usually leads to strong flooding (The Boiului, Brătcuţei, Mişidului Valleys etc.).

Generally speaking, the state of the hydrographic network is strongly unsettled, fact that is due, on the one hand, to the direct infiltration into the limestone substratum of the precipitations waters, and on the other hand to the processes of karstic catching, which imply a great number of underground drainages.

As a consequence, the permanent surface run-off is restricted to the main collector or to the catching basins developed on other rocks than karst (to be continued in part II).

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VERÄNDERUNGEN DER GEOGRAFISCHEN LANDSCHAFT IN VERSCHIEDENEN HISTORISCHEN PERIODEN IN DER SIEBENBÜRGER HEIDE

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Rezumat. Câmpia Transilvaniei, ca şi areal de izolare centrală în cadrul Depresiunii Transilvaniei, relevă numeroase trăsături distincte în ceea ce priveşte evoluţia paralelă a antropicului şi a peisajului geografic iniţial. În diferite perioade istorice prezentate în lucrarea de faţă, aceste două elements se întrepătrund evolutiv şi creează noi tipuri de peisaje antropizate. Transformarea elementelor iniţiale ale peisajului silvostepic dau caracteristici noi prin introducerea componentelor peisajului antropizat; hodăile, ocuparea arealelor ripariene, transformarea frunţilor de cuestă vor conduce spre noi dimensiuni ale spaţiului locuit şi vor crea peisaje antropizate care vor influenţa evoluţia viitoare a spaţiului rural – izolat şi cu fluxuri energetice centrifuge ale regiunii.
Cuvinte cheie: peisaj geografic, peisaj antropizat

Für die Vervollstandigung einer geografischen Analyse einer so komplexen territorialen Einheit wie die Siebenbürger Heide ist es zwangsläufig, uns mit der zeitlichen Entwicklung des anthropischen Faktors – sowohl durch seine numerische Komponente, als auch durch das zeitliche Werden der menschlichen Siedlungen – zu beschäftigen. Es wurde festgestellt das sich die Forscher im Laufe der Zeit viel zu viel mit der erosiven Tätigkeit naturlicher Herkunft und weniger mit der destruktiven Rolle der anthropischen Tätigkeiten, die für eine Region wie die Siebenbärger Heide ein besonders relevantes Element darstellen, beschäftigt haben (M. Buza, 2000).

Auch in diesem Fall sind die Unterschiede zwischen dem Norden und dem Süden der Heide klar ausgedrückt. Die Unterschiede zwischen dem waldsteppischen und dem Waldcharakter sind aus voranthropischen Etappen in dieser Region erhalten geblieben, aber wir werden die wesentlichen Eingriffe in der Landschaft seit der Bevölkerung der Region betonen. Wenn wir die *korrekte* historisch-geografische Idee voraussetzen, laut der der südliche Raum *waldsteppisch vererbt* und nicht erlangt war und das diesem inmitten der historischen Region *Transilvanien* – jenseits der Wälder – gelegenen Raum nicht das Waldspezifikum assoziiert wird, dazu die durch Urkunden und archäologische Studien bestätigte Anwesenheit des Menschen seit dem *Neolithikum* auf einem waldlosen Gebiet (die Siedlungen der *Gruppe Mod* gegen Westen und bei Zau de Campie gehören einer *agropastoralen* Gesellschaft), so können wir behaupten das die Landschaft der Mierescher Heide (der südliche Teil der Siebenbürger Heide) gröβtenteils unverandert geblieben ist. Die primitive Landwirtschaft, von der die Auen und die Stufenflächenweiden benutzende Viehzucht dominiert, hat keine bedeutende landschaftliche Veränderung bewirkt. Außerdem bestätigen die alten Bezeichnungen „Heide" und „Heuwiesen" das allgemeine Aussehen der Region schon

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seit dem Anfang ihrer Besiedlung. Trotzdem existieren Anderungen die einige Forscher auf keinen Fall als Details betrachten.

Im *Äneolithikum* (2500-2000 v.Ch.) wird die Anwesenheit der Cofofeni-Kultur im Mieresch-Tal erwähnt; es ist allgemein eine Etappe schwacher Bevölkerung, vor allem im nördlichen Teil. Desgleichen weist der südliche Teil der Heide eine dem Norden klar überlegene Siedlungsdichte auf; hier wurde die „Burg der Heiden" auf dem Gebiet der heutigen Ortschaft Şincai entdeckt, eine genauso wichtige Siedlung wie diejenigen um die Salzvorkommen (Sic). Es ist möglich das während dieser Periode die Viehzucht eine wichtigere Rolle als die Pflanzenkultur spielte (V. Lazăr, 1995, zitiert von Al.S. Bădărău, 2000).

Die *Bronzezeit* (2000-1300 v.Ch.), die groβe Kontroversen bezüglich dem *Beginn der Rodungen* in der Siebenbürger Heide infolge der Einführung besserer Werkzeuge geschaffen hat, erhält Siedlungen vor allem im südlichen Teil. Wenn eine Landschaftsveränderung glaubwürdig sein kann, dann ist sie durch Urbarmachung und nicht durch Rodungen erfolgt, da das nichtbewaldete Gebiet überschüssig war; au˛erdem würde die Bevölkerungszahl solch eine Tätigkeit nicht rechtfertigen. Die archäologischen Ausgrabungen beweisen das die Wohnungen und Reste auf oder in Tschemosems liegen (Al.S. Bădărău, 2000).

Siedlungen der skythischen Völker (Steppenvölker) von Budeşti und Frata, aus der *Eisenzeit,* sind erstmals au˛erhalb der Täler gelegen, was die Einheitlichkeit des waldsteppischen Charakters in der Mierescher Heide beweist.

Im Norden, in der Somescher Heide, erscheinen mit der Perfektionierung der *Eisenwerkzeuge* die Rodungsvoraussetzungen. Hier kommen Spuren dakischer (und keltischer) Siedlungen vor, desgleichen im Westen der Region, wo der Salzabbau vorkommt. In der römischen Periode steigt die landwirtschaftliche Nutzung und der Salzabbau (Sic, Valea Florilor); der Haupteinflussraum liegt im Westen (in der Nähe der Zentren Napoca und Potaissa), wo auch eine Verbesserung der Infrastruktur zu bemerken ist. Gleichzeitig mit der hauptsächlich landwirtschaftlichen Nutzung ist auch ein anhaltendes Wachstum der Bevölkerung festzustellen.

Ein andauerndes Wachstum des anthropischen Druckes auf die Landschaft erfolgt im Mittelalter. Aus historischen Daten (Şt. Pascu, 1979) ist leicht zu erlesen das, mit Beginn des 11. Jh., der anthropische Druck in der Siebenbürger Heide das Gleichgewicht der nüturlichen Geosysteme störte. Als Argumente stehen die für diese räumlich relativ kleine Region sehr frühen urkundlichen Erwähnungen (Tabelle 1). Zwischen 1075 und 1300 gaben es schon ca. 60 Dörfer im Westen und Nordosten der Region und vier Dörfer im zentral-südlichen Teil. Die ältesten davon sind *Ocna Cojocna, Mociu, Sântejude, Ocna Sic, Soporu (de Câmpie)* u.a. Davon waren Cojocna und Sic dank ihrer Salzabbauungen seit der dakisch-römischen Periode bekannt. In der übrigen Heiden erscheinen die Dörfer nur sporadisch, vor allem in den Randgebieten. Zwischen 1301-1350 kommt eine wahre Explosion urkundlicher Erwähnungen vor (etwa 150), wobei zu bemerken ist das die Dörfer die zentralen und südöstlichen Gebiete der Region einnehmen. Es ist eine rurale Agglomeration im westlichen Teil zu bemerken, als Folge der naheliegenden Zugangswege aus dem Kleinen Somesch-Tal. Die nächste Periode (1351-1400) bringt weitere 40 urkundliche Erwahnungen in der Siebenbürger Heide, wobei die Dörfer hauptsächlich in den Randgebieten liegen: Osten und Südosten, Nordosten und das zentral-nördliche Gebiet. Die „Füllung" des geografischen Raumes der Heide erfolgt nicht einheitlich, wie auch zu erwarten. Es verbleiben zwei fast siedlungsleere Gebiete: der Nordwesten und der Südwesten der Region. Dieser Zustand ist fast unverandert bis in der Gegenwart geblieben, weil der Nordwesten der Heide ein Gebiet mit überdurchschnittlichen Waldflächen und mit einer grö˛eren Reliefsenergie ist (die Gemeinden Mica, Unguraş und teilweise Braniştea), und der Südwesten (die Gemeinden Cojocna, Ceanu Mare, Tritenii de Jos, Viişoara und teilweise Chețani) sich im Gegenteil durch eine bedeutende Ausdehnung der Heuwiesen und Weiden – gegenwartig Ackerland – auszeichnet, dazu kleinere Niederschlagsmengen und quantitativ und qualitativ minderwertiges Oberflachen – und Grundwassernetz. Der Salzabbau von Cojocna, im Zusammenhang mit den *„rumänischen politischen Formationen der 12. und 13. Jahrhunderte"* erwähnt (Şt. Pascu, 1979) trug nicht, wie erwartet, zu einer Entwicklung eines Siedlungssystems bei. Im Nordwestlichen Teil erwies sich die *befestigte Siedlung* von Unguraş (Şt. Pascu, 1979) nicht als ein handfestes Argument für das Erscheinen der benachbarten Dörfer.

Tabelle 1. Die urkundliche Bestätigung einiger Siedlungen in der Siebenbürger Heide (nach Şt. Pascu, 1979)

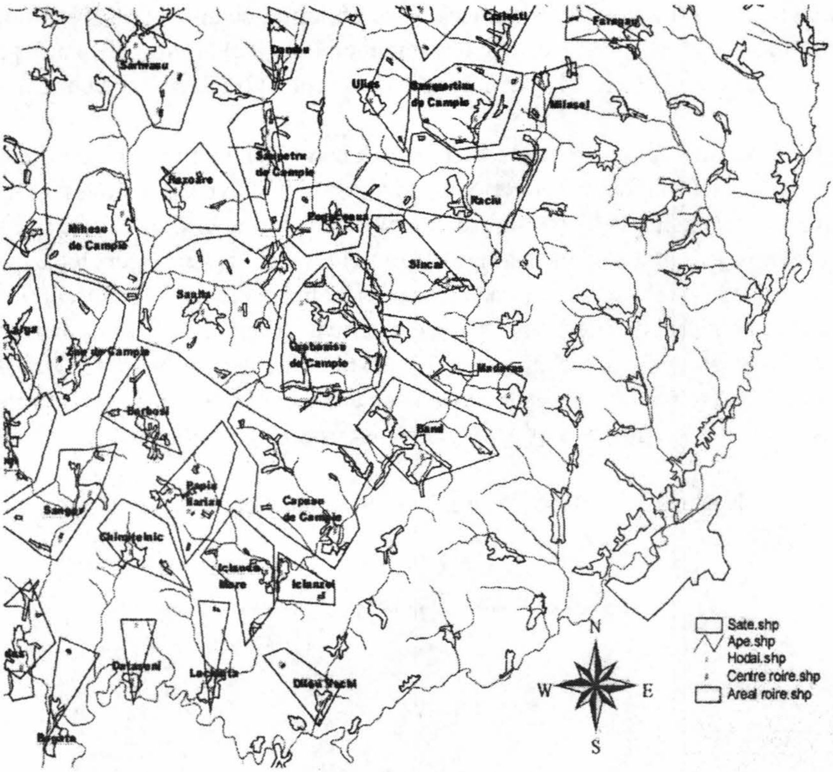
Ortschaftsname	Urkundlicher Erwähnungsname	Erwähnungsdatum
Bărăi	*Bărăii Româneşti*	1462
Bărbuşi	*Săcalu Unguresc*	1319
Boju	*Boju*	1400
Căianu	*Căianu Român şi Căianu Unguresc*	1468
Chiochiş	*Chiochişu Unguresc*	1598
Cojocna	*Ocna Cojocna*	Sec.XII-XIII
Cutca	*Cutca Română*	1445
Dâmbu	*(românii din) Dâmbu*	1434
Filpişu Mare	*Filipeşul Unguresc*	1439
Filpişu Mic	*Filipeşu Săsesc*	1439
Frata	*Frata Mare Românească şi Frata Ungurească*	1391/1410
Jimbor	*Jimborul săsesc*	1407
Lechinţa (Iernut)	*Lechinţa Română – Volahlekence*	1418
Măhal	*Măhalul Român*	1365
Miheşu de Câmpie	*Miheşul Unguresc şi Românesc*	1427
Mociu	*Mociu - aşezare sătească*	Sec.XII-XIII
Nicula	*Nicula Română*	1553
Pălatca	*Pălatca Română*	1499
Petea	*Petea Română*	1499
Răzoare	*Velcheru Român - poss. Volahalis Velker*	1418
Sângeorgiu de Câmpie	*Villae valachales*	1403
Sântejude	*Sântejude – aşezare sătească*	Sec.XII-XIII
Săuşa	*Săuşa Română*	1420
Sic	*Ocna Sic*	Sec.XII-XIII
Soporu de Câmpie	*Soporu – aşezare sătească*	Sec.XII-XIII
Stupini	*Stupinii Româneşti*	1397
Târguşor	*Oşorhelu Român*	1347
Ţigău	*Ţigău Săsesc*	1334
Tritenii de Jos	*Tritenii Româneşti*	1406
Unguraş	*Unguraş - aşezare întărită*	Sec.XII-XIII
Vaida-Cămăraş	*Pălatca Ungurească*	1499
Vişinelu	*Cistelec - Csehteleke*	1306
Zorenii de Vale	*Vale Sârbesc – Tothfalu*	1405

Die Verfolgung der Siedlungs – und Bevölkerungsevolution bietet unterstützende Argumente zur Bestätigung des *vererbten waldsteppischen Chamkters* der Mierescher Heide: die Ortsnamen „Heide" und „Heuwiese" kommen hier sehr oft vor (Karte 1.6.1); die Böden auf denen die Siedlungen der römischen und nachrdmischen Periode errichtet wurden sind mit den heutigen identisch; Geschichtsschreiber wie Xenopol *(Istoria Românilor din Dacia traiană,* vol. II) bestehen auf die Tatsache das die Grundbeschäftigung der Einwohner aus dem siebenbürgischen Hügelland der Pflanzenanbau (Kcam Tind Hirse) war, da die umliegenden Gebiete bewaldet waren und diese Beschäftigung für den Handel vorteilhaft war, alle Historiker behaupten das die Bevölkerung des siebenbtirgischen Hügellandes erst in der Zeit der Völkerwanderungen die Landwirtschaft aufgegeben hatten und Rodungen *au˛erhalb* dieser Region begannen; in der Siebenbürger Heide ist es genau die Mierescher Heide, die die neuen Verwaltungsformationen der vorigen Jahrhunderte (Hodăi = Gruppierung versetzter Bauernhöfe) eingliederte und die mit den gunstigsten landwirtschaftlichen Raumen ubereinstimmten (Karten 2 und 3).

Karte 1. Karte der Toponymen „Câmpie" (Heide), „Hodaie", „Fânațe" (Heuwiesen)
Incidența toponimelor „de Câmpie", „hodaie", „fânațe" în Câmpia Transilvaniei

Karte 2. Abschwarmeareale im SO der Siebenbürger Heide

Arealele de roire din partea de SE a Câmpiei Transilvaniei



Fur die gesamte Region ist die Anwesenheit der *Ackerterrassen* relevant, die, laut einiger Autoren (I. Cholnoky, 1913), von der sesshaften Bauernbevölkerung schon in der vorrömischen Periode geschaffen wurden, durch bekannte landwirtschaftliche Praktiken – des jährlich wiederholten, sukzessiven, talwärts orientierten Umsturzes der Furchen. Diese sind die relevantesten.

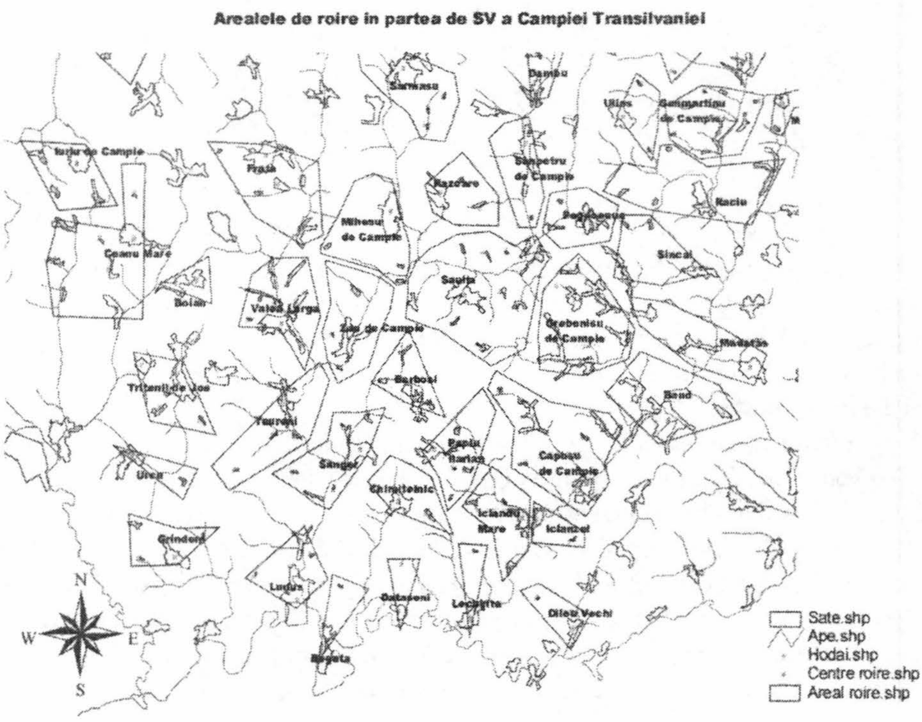
Elemente der Bodenbebauungstraditionen, was auch von den Historikern angezeigt ist. Das Verlassen und die Zerstörung einiger davon hatten die Abwanderung der Bevölkerung ins Tal als Ursache, in „ruhigen" Perioden, oder das Auftreten und Reaktivierung der Hangprozesse. Das Talwärtspendeln der Bevölkerung von den Ackerterrassen führte zu einer doppelten Toponymie in der Siebenbürger Heide: Agrişu de Sus, Agrişu de Jos; Rusu de Sus, Rusu de Jos; Tritenii de Sus, Tritenii de Jos, ein auch in anderen Regionen vorkommender Fall. Die abwechselnde Toponymie steht mit dem Sehwärmprozess in Verbindung (wobei die„oberen" Dörfer in der Regel in den Abschwärmegebieten gelegen sind – Karten 2 und 3). Die Doppeldörfer –, ‚de Jos" (Unter-) – sind ausnahmslos zahlreicher, mit einer jüngeren

Bevölkerung. Der Ortsnamen „de Vale" oder „Valea" („Tal") kommt auch sehr oft vor, doch haben diese Dörfer eine geringe Bevölkerung, da ihre Entwicklung von dem zeitweiligen hydrographischen Netz auf dem sie gelegen sind bedingt ist.

Der Übergang zu einer intensiveren Landwirtschaft in der zweiten Hälfte des 19. Jahrhunderts, die allmählichen klimatischen Veränderungen durch den Übergang zu einer Verringerung der jährlichen Niederschlagsmengen hatten als Folge die Vorbereitung des Untergrunds und des Bodens filr die morphodynamischen Vorgänge. Laut einiger Geografen wird die.

Verbreitung der von Erdrutschen betroffenen Flächen im Süden der Region durch diese im Suden der Siebenbürger Heide begonnenen intensiveren Landwirtschaft, die mit dem Areal der höchsten Bevölkerungsdichte übereinstimmt, erklärt. Andere schätzen das die Entwicklung mächtiger, glimeenartiger Erdrutsche in der Siebenbürger Heide nicht diesem Übergang und auch nicht der sich allmählich entwickelnder Viehzucht zuzuschreiben werden kana (plausible Grüde im Falle der flächenmä˛ig geringen Exdrutsche), da sie nicht erkennbare räumliche Bewegungen aufweisen (V. Gârbacea, mündliche Information). Dies Hypothese kann als richtig angesehen werden wenn man an den zahireichen Häuser, Strommaste oder Wege in deft Gebieten glimeenartiger Rutschungen denkt (Dâmburile, Mociu etc.).

Karte 3. Abschwärmeareale im SW der Siebenbürger Heide



Diese Periode des 19. Jahrhunderts, die den Übergang zu einer intensiveren Landwirtschaft bedeutet, spielte ebenfallseine wichtige Rolle in der Entwicklung der Weihersysteme in dieser Region (Pârâul de Câmpie, Şes und Fizeş), was eine Neuerwägung einiger wohnbaren Gebiete, wie z.B. Konfluenz der Flüsse im Inneren der Heide, als direkte Folge hatte (V. Surd, 1995; Maria Mihail, 1971).

Die N – S und W – O erstreckte Verkehrswege schafflendie Voraussetzsmgen der Siedlungsnetzentwick lung in der Siebenbürger Heide und des Erscheinens der Polarisierungszentren Mociu und Sărmaşu (Verwaltungszentren der ehemaligen Verwaltungseinheit Die Lage der Siedlungen in Taleinzugsgebieten schafften hier die Voraussetzungen für das Erscheinen der Wildbäche, die auf den erodierbaren Untergrund der Heide einen ausgezeichneten Entwicklungsraum fanden. Das relativ unebene Terrain der Region, vor allem im Norden, und das Schichtstufenrelief haben der irrationalen Landwirtschaft – das Pfülgen ltagst der Hanglinien, Überweidung, Monokultur – nicht standhalten können. Das ist gegenwärtig im Westen der Heide, auf dem Gădălin-Hügel, zu sehen, wo 5-7% des Ackerlandes unnutzbar geworden ist.

Schlussfolgerungen

Obwohl diese Region eine gewisse Uniformität der ökologischen Elemente vorzeigt, so ist das kein korrektes Bild, sowohl hinsichtlich der regionalen Bodennutzung, als auch hinsichtlich der zeitlichen Veränderungen der Nutzungsart (landwirtschaftlich) oder der Ausdehnung der Waldflächen. Im Falle der Waldflächen haben manche Geografen die Tendenz, sowohl die Amplitude dieser Veränderungen als auch die ökologischen Folgen zu minimieren. Ab den Abforstungen die in verschiedenen historischen Etappen die Somescher Heide und den zentralen Teil betroffen haben ersehienen essentielle Veränderungen in der Bodennutzung, durch das Ersetzen der Waldflächen durch Acker – oder Weideland, aber auch durch das Auftreten der Sträucher oder der Lichtungsfluren, im Falle der Brachlegung. Das Erscheinen und die Erweiterung der menschlichen Siedlungen (ab dem 11. Jh. Bis Mitte des 20. Jh.) beanspruchten natärliche Wiesen im stidlichen Sektor oder setzten die Abforstungen in der Somescher Heide fort.

Das ökologische Ungleichgewicht wird ab dem 13. Jh (13-17 Jh.) durch das Erscheinen der Dörfer in Taleinzugsgebieten, mit ihrer spezifischen, fächerartigen Entwicklung der bebauten Flächen und der Auslösung der Hangprozesse als Folge der Urbarmachung vergrö˛ert.

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THE TECHNIQUE OF COMMUNITY GENEALOGICAL RESEARCH. A PROPOSITION OF ANALYTICAL AND SYNTHETIC RURAL TABULAR RESEARCH

Viorel RUS*

Abstract. The population geography might also include in its achievements some results of genealogical researches, as inter-discipline elemnets, especially if these ones embrace whole communities such as the Romanian villages and cities. This might be because community genealogy allows structural and determinative interpretations of an anthropological, ethnic nature, population dynamics, the degree of endogamy, exogamy and consanguinity or even the psychological bases of the community ethos and in relation with family kinship. The great problem is represented by the technique of genealogical research over whole communities and the genealogical pattern used to render the results. The presence-study is devised based on the author's experience, acquired throughout his over 25 years of genealogical research in the village of Rebra, from the district of Bistrita Năsăud, situated on the valley of Rebra, 12 km from Năsaud. An original model of analytical and syntethic tabular genalogy is proposed, with crossed references, that can be used not only for rural or urban genealogical researches, but also in what concerns family researches.
Key words: Community genealogy, rural genealogy, genealogical research techinique, analytical synthetic tabular genealogical pattern, Năsaud's Rebra.

I. Introduction

It is said that ones who don't know their ancestors resemble to a rootless tree. And because strongly felt the need to have roots, within the past 25 years of my life I became preocuppied of the scientific research in the genealogy field.

After having found my predecessors, I said to myself that I could never offer a greater gift to the inhabitants of Rebra – where I was born and with whom I spent the most beautiful years of my life – than to offer them the opportunity to be aware of their roots.

My assidous preoccupations in thi ssense materialized in the year 2001 by the release, at the „Aletheia" publishing house in Bistrita, of an ample rural genealogy work entitled *Kinsfolk and Families in Rebra (1750-2000),* consisting 2 volumes with a total of 598 pages.

Here's a significant passage from the assessments concerning my work, written in its preface by professor d. Nicolae Edroiu, correspondent member of the Romanian Academy, president of the Heraldic, Genealogy and Sigillography Committee of the Academy – the subsidiary of Cluj-Napoca: „... **The research carried on by professor Viorel Rus outdoes everything achieved so far by its proportions and profoundness. The author himself worked hard for this achievement over a period of 25 years, investigating archives and field information, proceeding at the progressive and regressive approach on the evolution of a Transylvanian village but has built a history of its own."**

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The researches in the field of genealogy, without denying the importance of family genealogies, have been unanimously consonant into the fact that the research translation towards the wide Romanian social area, represented by the kinsfolk and the families from whole settlements as villages and cities are, will be able to determinate the surpassing by genealogy of its statue as auxiliary science of History, thus contributing to the pertinent explanation of Romanian economic, social, juridical, political, moral or religious phenomena, in order to legitimately scrutinize the future (Sever Zotta -- 1913, Dan Berindei - 1994).

Indeed, as we underline in the paper **„Rural genealogies and their importance. The Rebra case"**, devised for the 13th Congress of Genealogy and Heraldic of Iasi between the 15th and 18th of May 2003, the information comprised in a work of rural genealogy allow structural and determinative paraphrases of an anthropological, ethnic or sociological nature in what regards land possesion, social stratification and community solidarity, population dynamics, the degree of endogamy, exogamy and consanguinity or even the psychological bases of the community ethos in relations with family kindship, conclusions which actually mean coming closer to the axial analysis results of a rural genealogy.

II. The technique of community genealogical researches. A proposal of tabular analytical and synthetic rural genealogy

Our goal is to share our hard-work experience in such an accomplishment with those who might be interested in performing genealogical researches at the range of whole communities.

The first step to be made in such an approach, is **the identification of existing documents** in the district directorate of the National Archives, in the state archives such as town halls or churches or those owned by particular persons, which might be helpful in showing us what we can really on and whether there existed previous gelealogical preoccupations in what concerns the village or city we are interested in, thus establishing the time period throughout which we attempt to perform our investigation.

As we underline in our work in the „Thanks" chapter, we came upon documents that seemed to be revelead to us by God Itself, who literally urged us towards the accomplishment of our task (Viorel Rus, 2001).

Thus, we found **„The Fisical Conscription of the Bistrita Magistrate from 1750"**, knowing that this was the very year to begin our researches with, the **„Border Guards' Conscription from 1763-1764"** and the **„Border Guards' Land Inventory Book"**, up to date between 1790 and 1848 by the Nasaud Border Guards Regiment, noticing that we can rely on a certain documentary continuity, and we found the **„People of Rebra Cosnscription"**, initiated about 1890, in which the local priest Onisim Rotariu used to register the situation of Rebra families and the evolution of their structure up to the year of 1915, namely his death year, a work that was continued , though with numerous gaps, by his son Teofil Rotariu, a local priest himself up to 1940. This document was very helpful, as we had something almost done over a period of 50 years, and what is more, it proved an inspiration source for the original tabular model we were about to use further.

The second step to follow, perhaps the most difficult one, would be **to establish the group of people we could rely on** for helping us in our attempt, because being alone and regarded with hostility from everywhere could make us lose courage to begin, or sometimes, at mind-weighing moments, lose even the will to go on with our work or the hope that its results will ever be published.

These people are, for me, the ones about whom, in appreciation for their help, I talk about when referring to my work with the terms „our work" or the „work performed by us". And provided you follow the same „Thanks" chapter on the very first page of our work, you'll find there sixteen names standing for the people that are actually „WE". One needs lots of persuasive force, lots of diplomacy and tact in dealing with our helpmates, among which there must be specialists in this field, the mayor and the priest, the secretary and the agricultural clerk from the village hall, the village's teachers, and especially the history teachers, the boldest old people in the village, even one's own family who must know that the very mentioning of their names at the end of the book we shall eventually edit will ensure their posterity.

There follows **the make-up of the work's plan and of the genealogical pattern** we mean to use, according to the informal materials that can be obtained out of documents, in order to know which information will be necessary to us so as to establish the practical research mode afterwards.

We chose to begin our work with a short history of the village, we pursued with short histories of the 56 kinsfolk we had identified as existing in the past, set by their names in Romanian alphabetical order, out of which 48 old kinsfolk presently have descendants in the village, whereas 8 of them have disappeared as names with time, either because they did not have offspring or male offspring for a certain generation, or because their offspring left to other places, as we followed the paternity.

We found that for the village's kinsfolk, groups of families with the same ancestors, corresponded 123 old Rebra families at which we could surely find offspring, out of which descend the 708 own householder families that lived in Rebra in the year 2000.

The 123 old families were each one arranged by kinsfolk according to their short history, they being regarded as the first or the initial generation of the genealogy. Furthermore we tabularly described their offspring from every branch that formed during 5, 6, 7, sometimes even 8 generations.

We chose to achieve the genealogical study after an original tabular pattern that allows genealogical pursuit both on an ascendant (analytical) line and a descendant (synthetic) one, to be presented as follows:

GENERATION	FAMILY DESCENDANTS	YEAR BIRTH/ MARRIAGE/ DEATH	HUSBANDS OR WIVES OF DESCENDANTS	REMARKS
NO. 1.	2.	3.	4.	5.

As for the actual way of dealing with the table, some specifications need to be made:

1. The column 1. is meant to number the generations comprised in the research, thus facilitating the reader's pursuit of his/her own ascendants or descendants. Because, for example, by acknowledging that he/she belongs to the 5th generation in relation to the family noted as the first generation, he/she canknow that he/she can find his/her parents in the 4 generation, his/her grandparents in the 3^{r}, his/her great-grandfathers in the 2nd, his/her great great-grandfathers in the 1st, whereas in the 6th, 7th, or 8th generations he/she will find, upon occasion, his/her children, grand-children and great grand-children;
2. In column 2. we noted the descendants of the family regarded as the 1st generation, both male and female ones, but so as not to make the documentation more difficult, we enlisted only the ones to reach the minimum age of 20 before their death, or the ones to have offspring and hence were significant for the future evolution of the kinsfolk, exception making the forthcoming generations in relation to which the evolutions will succeed the ones we wholly enlisted;
3. In column 3. we distinctly inserted, for each descendant, his/her birth, marriage and death year. Where we could not find data, or marriage and death have not yet occurred, we let a blank space for further additions. Besides that, as a rule, the tabular pattern we created offers the possibility of continuing its completion by the future descendants of any kinsfolk of family, if interested;
4. In column 4. we enlisted the husbands or wives of the family descendants using as identification data their first and last names, their father's first name, their birth or death year. If they were from Rebra, we mentioned the number of the family they descend of and the work volume they can be found in according to their family, because each married person appears in the work twice, both at the family in which he/she was born and at the family to adopt him/her by marriage, once as a descendant and secondly as husband or wife, allowing the people of Rebra to easily pursue both their paternity and maternity ascendants in every previous generation except the exogamous marriages where, beside identification data, we only mentioned the provenance place of the alien husband or wife;
5. The column 5. „Remarks" is meant to comprise additional information that may prove interesting, about each descendant, such as: cause and place of death for the deceased, residence place for the living but remote ones, house number for the village residents, and so on.

I need mention that the house numbers show-down for the village residents allow us to elaborate a compendium of the genealogical tables, so that every villager to be able to easily find his/her family, the volume and the work page where he/she is enlisted.

All these stages being dealt with, there follows **the work's research and redaction activity,** which for us represented firstly the copying of the archive documents whose originals could not be borrowed, action that took us a great amount of time and wasted lots of energy (nowadays when every institution is endowed with a „Xerox" machine, this operation is quite at hand, even though it may involve a certain financial effort), but during which the help we received from the city hall's clerks was notable, and then the manuscript completion of the genealogical tables dependent on some kinsfolk and family cards that were devised based on the documents we were in possession of and finally the compilation of a short history for every kinsfolk. We need specify that in our research, the family investigations merely had the role of confirmation and completion of the documents' information, which we believe to ensure a greater accuracy of the research's content, being aware of the subjectivity and the veil of forgetfulness to exist in any man's brain, no matter how well-willing he/she might be.

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THE DISTRICT OF NĂSĂUD – ASPECTS OF HISTORICAL GEOGRAPHY

I. BÂCA*, A. ONOFREIU**

Abstract. The district of Năsăud (1861-1875) represents an administrative-territorial entity superposed on the area of the former Frontier Regiment of Năsăud (1762-1851) and constitutes an important stage in the evolution of the district of Bistriţa-Năsăud, having specific features under historical, social-economical, cultural, administrative and territorial aspect. This was organized in 6 circles that included 46 villages. The villages' territory consisted of the place (the inside area and the estate) and the mountain areas, inherited from the previous administration, all of them defined by toponyms of Romanian origin, which underlines the preservation of the native specific, in spite of the hostile historical events that affected these places throughout the time.
Key words: The Frontier Regiment of Năsăud, The District of Năsăud, administrative-territorial organization, toponymy.

1. Geographic setting and spatial relations with the neighbourly administrative units

The district of Năsăud, as an administrative-territorial unit spatially superposed on the area of the former Frontier Regiment of Năsăud, took about 66% of the present surface of the district of Bistriţa-Năsăud, being situated at confluence of the mountain crown Ţibleş – Rodna – Suhard – Bârgău – Călimani with the smooth hills of Transylvania, a.k.a. the hills of Năsăud, Bistriţa and Suplai. This geographic conditioning, as well as the complementarity relations established between the two morphofUnctional units have been decisive for the historical, social-economical, administrative and cultural evolution of the human communities along the morphohidrographical axes to drain this region.

Well integrated historically and administratively, the district of Năsăud was neighbours at North with the Maramureş county, at East with Bucovina and Moldova, at SE with Turda county, at SW with the German District of Bistriţa, Cojocna and Dăbâca counties, and at west with the county of Solnocul Interior (fig. 1).

2. Historical dimensions

The revolution of 1848-1849 in the Romanian countries strongly shattered the obsolete edifice of the Habsburg Empire and had noticeable consequences upon the national conscience of the Romanian population in Transylvania (Şotropa, 1975, Onofreiu, 2004). Henceforth, along with the historical transformations to be felt all over Europe, on the 22nd of January 1851, **The 2nd Frontier Regiment of Năsăud,** as well as the others alike in Transylvania, is abolished.

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Due to these circumstances the area of the former regiment of Năsăud needed a new administrative geography, imposed by the tendencies of the neoabsolutist period that focused towards territorial linking, either to the areas inhabited by german population (The german district of Bistrița), or to the neighbour counties (Solnocul Interior, Cojocna, Dăbâca and Turda) that were under hungarian administration. This context required a new social mentality so as to find the most appropriate organizing method to entirely preserve the specific features of the population from the former military state (Lumperdean, 1994, Onofreiu, 2003).

Within the next period the Năsăud intellectuals converged their efforts to organize the former Frontier Regiment into a new political, administrative and social-economical entity „that was not to be divided and enclosed to other counties and districts, but to stay as an unique indivisible region" (the Rodna Vicariate, ABN, 1861). Thus, in the context of Transylvanian reorganization through reestablishing of a government and of the former administrative-territorial forms specific to the Austro-Hungarian Empire, that is to say the hungarian and german „chairs", the free royal citadels and the privileged „oppides" prior to the year 1848, the Court of Vienna allows the Frontier Regiment of Năsăud to organize itself as a set district, with its own jurisdiction. As a consequence, after 10 years of social unrest regarding the preservation of national identity, by the High Majestic Decision of 24th March 1861 the **District of Năsăud** comes to life, having its residence at Năsăud.

3. Administrative dimensions

According to the law XLII/1870 regarding the administrative reorganization, the 44 frontier villages together with other two villages from Bucovina (Cârlibaba and Coşna), were grouped in six circles (Onofreiu, 2003, 2004), leaded by a circual jude, each of these circles including several villages as follows:

– **the circle of Năsăud,** with the villages of Năsăud, Salva, Rebrişoara, Rebra, Parva, Telciu, Hordou (Coşbuc), Bichigiu and Romuli;

– **the circle of Sângeorgiu (Sângeorz-Băi),** with the villages of Sangeorgiu, Ilva Mica, Leşu, Feldru, Nepos and Sâniosif (Poiana Ilvei);

– **the circle of Rodna,** with the villages of Rodna, Șant, Maieru, Măgura Ilvei, Ilva Mare, Cârlibaba and Coşna;

– **the circle Borgo-Prund (Prundu Bârgăului),** with the villages of Rusu Bârgăului, Josenii Bârgăului, Mijlocenii Bârgăului, Susenii Bârgăului, Prundu Bârgăului, Bistrija Bârgăului, Tiha Bârgăului and Mureşenii Bârgăului;

– **the circle of Zagra,** with the villages of Zagra, Mocod, Mititei, Poienile Zăgrii, Plai (Suplai), Gaureni and Runcu Salvei;

– **the circle of Monor,** with the villages of Monor, Gledin, Şieuț, Nuşfălău (Mărişelu), Sântioana, Morareni, Ruşii Munți, Ragla and Budacu Românesc (Budacu de Sus).

Together, these six circles and the 46 component villages formed **„The city" of Năsăud,** acknowledged at the conference on the 15th of December 1871 (Onofreiu, 2004). The circles' establishment was based on historical criteria, linked to the organization of the former Frontier Regiment (Şotropa, 1975, Mureşianu, 2000) and on geographical criteria, imposed by the relief configuration, each circle being superposed over a morphohydrographical axis along which the component villages should allign.

In order to ease and customize the administration, in 1872 takes place the reorganization of the District of Năsăud in 7 large villages and 39 small ones grouped into 12 notarial circles and 6 administrative circles. This approach's goal was a better solving of the problems „regarding the administration, the education, culture, sanitary state, the accomplishment of financial obligations, the communication means state, land laboring and the rational exploitation of the pastures and forests" (Porcius, 1928). So, the administrative situation was as follows:

– **the circle of Năsăud** – large village Năsăud, small villages Salva, Hordou, Bichigiu, Telciu and Romuli to form a first notarial circle, Rebra, Rebrişoara and Parva to constitute a second notarial circle;

– **the circle of Sângeorgiu** – large villages Sângeorgiu and Feldru, small villages Ilva Mică, Leşu, Poiana Ilvei and Nepos to form a notarial circle;

– **the circle of Rodna** – large villages Rodna and Maieru, small villages Şanţ and Cârlibaba to form a first notarial circle and Ilva Mare, Coşna and Măgura Ilvei for a second one;

– **the circle of Prundu Bârgăului** – large village Bistriţa Bârgăului, small villages Tiha Bârgăului and Mureşenii Bârgăului which formed a first notarial circle, Rusu Bârgăului and Josenii Bârgăului for a second one, Prundu Bârgăului and Susenii Bârgăului to group for a third one;

– **the circle of Zagra** – small villages Mocod, Mititei, Runcu Salvei to form a first notarial circle and Zagra, Poienile Zăgrii, Plai and Găureni for a second one;

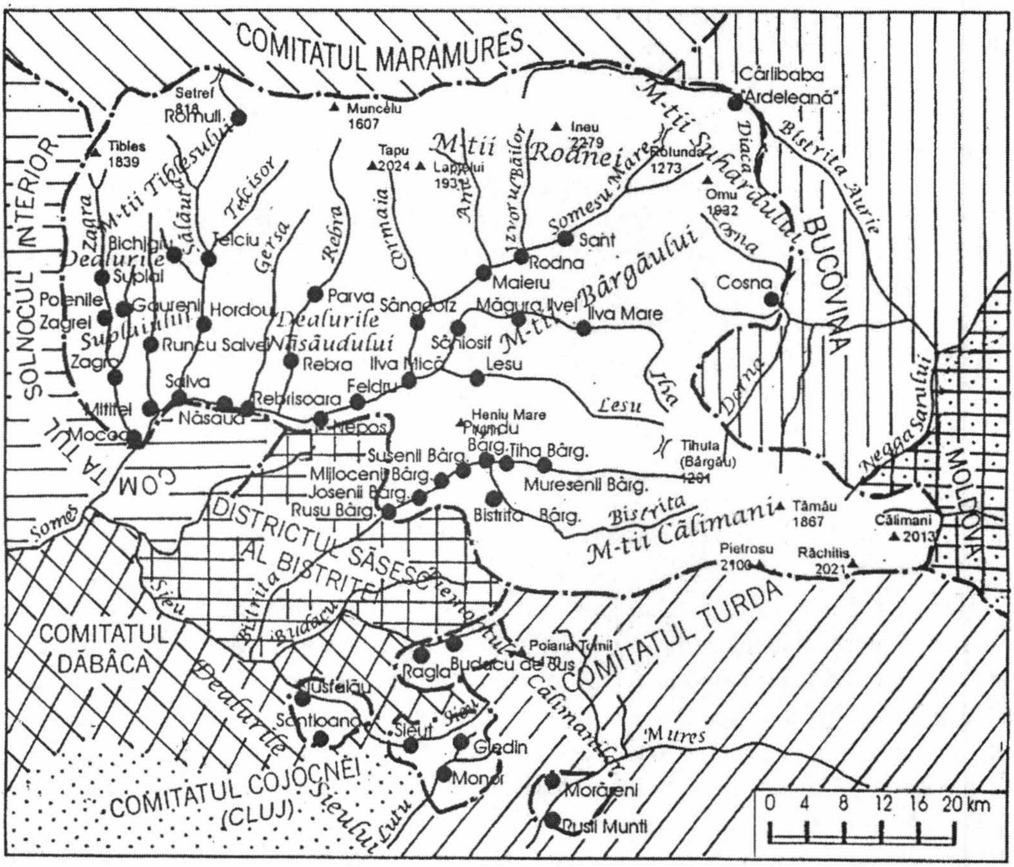
– **the circle of Monor** – large village Monor, small villages Budacu de Sus, Ragla, Şieuţ, Mărişelu and Sântioana grouped into a first notarial circle and Gledin, Ruşii Munţi, Morăreni to form a second one.

4. Geographic relations

Out of a questionnaire required in 1875 by the Statistics Committee for „composing and lithographiation of a survey map for the whole District of Năsăud" there can be distinguished a series of information regarding the land structure and the used toponymy for this geographic area. On the whole, in the structure of the land fund the following grounds can be found: plough-lands, hay lands, pastures, forests and unproductive lands (rocky lands, roads, swamps etc). As for villages, the land structure varies function of geomorphometric conditionings. Thus, in the villages with a hilly relief, plough-lands and hay lands are preponderant (Şieuţ, Sântioana, Gledin, Monor, *Zagra,* Mititei, Mocod, Salva, Ragla, Mărişelu, Năsăud, Rusu Bârgăului, Josenii Bârgăului), and in those with a mountainous relief, large surfaces are taken by pastures, hay lands and forests (Rebrişoara, Rebra, Rodna, Sângeorz, Ilva Mică, Ilva Mare, Leşu, Tiha Bârgăului, Mureşenii Bârgăului, Bistriţa Bârgăului).

The villages' territory consisted of two administrative-functional units, respectively the village's place and the mountainous parts, specified on survey papers. **The village's place** included the inside area and the estate, and **the mountainous parts** were situated out of the villages, as they were inherited from the times of the Frontier Regiment, being allocated to the mountainous areas near the villages, so as to facilitate the guarding and the administration of the frontier guards' pastures and forests. In this way, the villages of Mocod, Mititei, Zagra, Runcu Salvei, Rebrişoara, Rebra, Salva, Hordou, Bichigiu and Năsăud had mountainous parts in the Rodnei mountains, the villages of Poienile Zăgrii and Zagra had their parts in the Ţibleş mountains, the villages of Monor, Gledin, Şieuţ, Sântioana, Mărişelu and Budacu de Sus owned parts in the Călimani mountains, whereas the villages from the Bârgău valley used to have properties in the mountains of Bârgău and Călimani.

Fig. 1. The District of Năsăud – Geographic and geopolitic position, spatial extension and administrative structure (after Mureşianu, 2000, modified)



Both the village's place and the mountainous parts were divided into lines and place parts, expressed through different toponyms which we cathegorized as follows:

– **morphonyms,** referring to certain relief characteristics – Rotundu, Netedu, Vf. Dealului, Râpa, Măgura, Podereiu, Zapodia, Obcina, Muncel, Vârtoapele, Măgurele, Dl. Gruejilor, Locurele, Pietrişul, Moinele, Lunca, Piciorul Lung, Valea Glodului etc;

– **hydronyms,** referring to distinct hydrographic aspects – Fântânele, Izvorul, Valea Fântânei;

– **bionyms (fitotoponyms, zootoponyms),** given according to the vegetal and animal community to dwell in those places – Plopişu, Frăşinis, Dl. Paltinului, Valea Plopului, Valea Ursului, Dl. Cioroiului;

– **anthroponyms,** after the names of people who owned or used certain lands – Podereiul Blidarului, Poiana lui Doboş, Piciorul lui Vlad ceel Mare, Valea lui Climu;

– **oiconyms,** generated by certain economic and social activities (clearing, pasture) – Pleşa, Runcuri, Dl. Bisericii, La Colibi, Fata Crucii, Mănăstirea etc.

This terminology, which defines different geographic phenomena, underlines the preservation of the Romanian specific within the District of Năsăud, in spite of the hostile historical events that affected this region throughout the time. The rich and various toponymy illustrates the tight interconditionings between the native population and the natural environment, as well as the dynamics of social-economic life in these places.

In conclusion, we need to mention that the district of Năsăud, as an administrative-territorial entity derived from the former Frontier Regiment of Năsăud, constitutes an important stage in the evolution of the district of Bistriţa-Năsăud, characterized by specific features under historical, social-economical, cultural, administrative and territorial aspect and by complex geographical relations that reflect in the way of organizing, using and defining of the space.

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Studii şi cercetări, Geologie-Geografie 10, 2005, Bistriţa, p. 143-146

THE RODNA SETTLEMENT – HISTORICAL GEOGRAPHY MARKS

Mircea MUREŞIANU*

Abstract: The presence of the golden – argentiferous veins, the mining and the transit over the mountains were the grounds for the genesis and the evolution of the oldest human dwelling place from the upper basin of the Someşul Mare river, namely Rodna, documentary attested in 1235 when, in the Russian chronicles, they mention the voyage to Hungary of the duke Daniel of Haliciu who followed the road leading over the tops of Borsuc to end up at the mines of Rodna. Form the central nucleus of the medieval settlement, the place has underwent a continuous expansion towards the watersides ofSomeşul Mare, Izvorul Băilor or the Someş mesas, reaching to an area of almost 200 hectares nowadays.
Key words: „oppidum", Rodna, settlement

1. The medieval Rodna – Grandeur and decay

Rodna is the oldest rural human dwelling place from the upper and middle basin of the Someşul Mare river, documentary attested in 1235. Due to the mines in the area, long before the first attestation, Rodna was the most important locality on the Someşul Mare valley, holding as well the headquarters of the Valley Voivodeship residing every settlement from Mocod upwards. Thus, Rodna has always imposed as a zone center or a fair, having all the necessary endowments for collective leadership and mining, trade, guardianship and security, as well as the accommodation means for those who were traveling over the mountains.

The shaping of this prosperous settlement at the feet of the Rodnei and Bârgău mountains, towards the source of Someşul Mare, created the premises for the genesis of many subsequent settlements on Someş and Ilva rivers, as a result of some intense geodemographic swarming phenomena.

The initial settlement, preferred by the Romanian autochthons even from ancient times, was a washing terrace which nowadays houses the village cemetery, a place where, on the occasion of digging a grave, there was discovered a stone axe of Neolithic age.

By the time the first groups of German colonists and Benedictine monks came by, in the 12th century, the autochthonous population was exclusively Romanian, which is also proven by the dramatic moments of the Mongolian – Tartarian invasions from 1241-1242, when the Romanian priests Domide, Marcu and Anastasie are mentioned. It is obvious that a number of three priests could not serve but for a numerous community that had long existed in a certain area. On the other shore of Izvorul Băilor, the colonists, displaced here to revitalize the mining and to guard the Rodna pass (Rotunda), for the benefit of the Hungarian kings, occupied the central zone of the actual settlement (a rather narrow space, within the movement

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habitat of Someşul Mare and Izvorul Băilor), thus shaping the medieval center of the prosperous „oppidum" of Rodna.

In support of their control of Transylvania, the arpadian kings, declared as „apostolic" by the Pope and they themselves entitling that way, based their governing actions on the catholic missionaries, namely priests and monks, who had as goal the religious conversion of the natives.

The „oppidum" of Rodna from the 12th and 13th centuries had in its center, imposing, the only Benedictine monastery on the Upper Valley of Someşul Mare. The initial monastery, raised in the 12 century and consisting of a stone church surrounded by the dwelling places for the local clergy as well as missionary and cruciate monks who were responsible for guarding the mines and the important institutions of the new city. After being demolished in 1242 by the mongolian- tartarian praying hoards, in the second half of the 13th century there was raised, instead of the old buildings, an imposing Dominican monastery, also destroyed by the mongols and the tartars in 1285.

Out of a document of public notoriety devised in 1268 on the occasion of a transaction between high dignitaries from the family of Rodna counts, there distinguish several marks regarding the aspect of the settlement, and from a succession allotment between the same counts there results that in Rodna there were the following: the palace inhabited by count Nicholas, houses for the mine workers and metal weighing, taverns, bakeries, butcheries, bootmaking shops, slaughter houses, some deserted houses, orchards, fields and forests in the neighbourhood with hunting and fishing places, gold and silver mines, every construction bearing the settlement's aspect of a city.

Even if the devastating barbarian raids from the 13th century greatly harmed the burg of Rodna, it manages to recover in several decades of peace, tranquillity and security in the area, a fact proven by the year 1412, too, when Stiboriu, the voivode of Transylvania, sets new customs regulations for Rodna, which were absolutely necessary as a result of the appearance of the medieval state of Moldavia. There follow two decades of floods, fires and diseases, but also the revolt of the Transylvanian peasants in 1437-1438, on which the miners from the District of Rodna took part together with many Romanian peasants, eager to see their indebtedness towards authorities favorably regulated.

After this event, many of the Romanians from Rodna, so as to avoid being executed or mistreated, crossed the border to Moldavia, whereas the remaining ones, together with „the deserted citadel" from Rodna and the belonging villages, were placed under the administration of the hungarian count Mihail Jakab of Kusal, as shown in a document from 1440, elaborated by the convent of Cluj – Mănăştur.

Although, beginning with 1475, the administration of the area was performed by the senate of Bistrița City, Rodna undergoes a prosperous period emphasized as well by the edict of 1520, signed by king Ludovic the 2nd, according to which Rodna receives a part of the mines to administrate on its own, along with the right to hold a weekly fair and to have its own emblem or sign.

In the 16th century, for short periods of time, Rodna and the villages from the upper side of Feldru passed under Moldavian rule.

2. Rodna's alignment to the realities of the military border and those of the contemporary period.

The documents at the beginning of the 18th century come to acknowledge the participation of Rodna and Maieru people to the anti-Habsburg revolt leaded by Francisc Rakoczi, but also the great damages caused by the latest tartar invasion in the area (1717).

The dramatic event from 1717 considerably reduced the geodemographic potential of Rodna, as part of the local people who escaped alive chose to flee to more secure areas, whereas others retreated along with their households to some hidden places at the feet of Măgura Mare, in the glades and openings on the hill of Durnele, on the large terrace left from Someşul Mare („Poderei") or on the valley Izvorul Băilor. Ever since then and up to the militarization of Rodna valley, for over four decades, the Rodna settlement got divided, becoming polynuclear, with a rather compact central habitat, but with many deserted houses, along with several scattered nuclei, out of security reasons, in the above mentioned areas.

Making Rodna become a part of the spatial, administrative and politic-military system of the Năsăud borderline in 1762 started, through the decisions and ordinances elaborated by the authorities, a powerful trend to relocate the remote groups of households both towards the central nucleus of the medieval city and near the nucleus of the nowadays cemetery, namely „Su' Coastă". The density of households considerably increases in the central area of the actual settlement, especially after 1764 when Maria Teresa donates to the Romanian border guards of Rodna the area surrounding the Dominican basilica ruins, where, at the beginning of the 19th century, the Romanian autochthons raised a beautiful and ample Greek Catholic church, consecrated in 1825.

By analyzing the Austrian topographical maps elaborated between 1850 and 1890 (1: 75,000) we ascertain that, towards the end of the military borderline, the Rodna settlement had already been shaped under its actual form („unfolded horizontal bear-skin" – as seen from the Bârgău Mountains, or a „cross" – as seen from the Rodnei Mountains).

The dynamics of the structural – physiognomic typology of the Rodna settlement had the following direction: central medieval settlement nucleus with compact spaces alternating with dispersed ones; polvnuclear dispersed village, with a relatively compact center during the 17th and 18th centuries (the pre-militarization period); dispersed village, from the period of the military borderline up to the beginning of the 20th century, after which the habitat of the Rodna valley was characterized by a mixture of areas with dispersed households and overcrowded areas with compact central sectors.

In the decades after the 1st World War, the Rodna settlement underwent a noticeable increase of density in what concerns the inter-city constructions (from 8/hectare in 1930 to 21/hectare in 2002), due to its widening towards Sant, Valea Vinului and Anies and to the concentration of some central habitats.

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Fig. 1. The temporal-spatial dynamics of the Rodna settlement

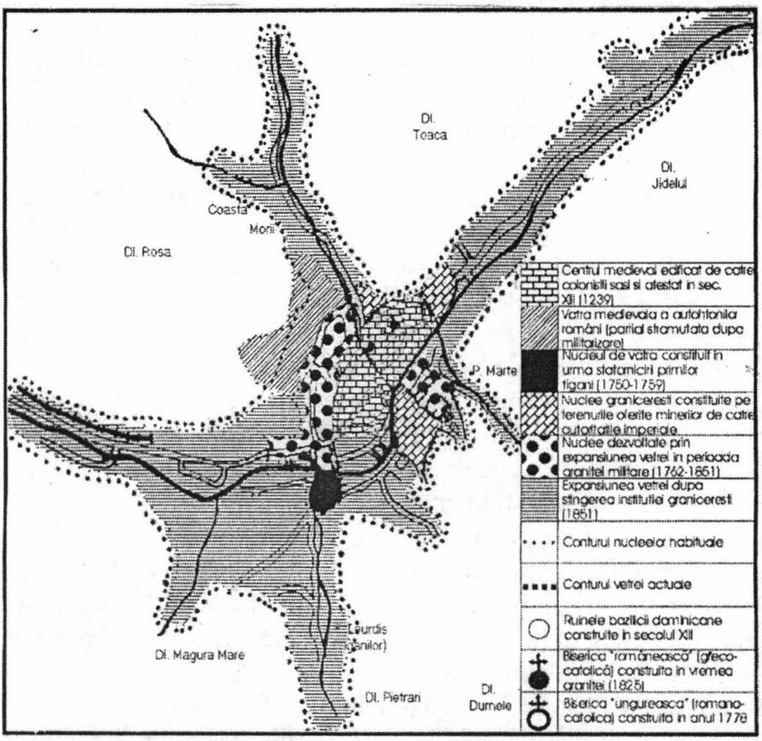
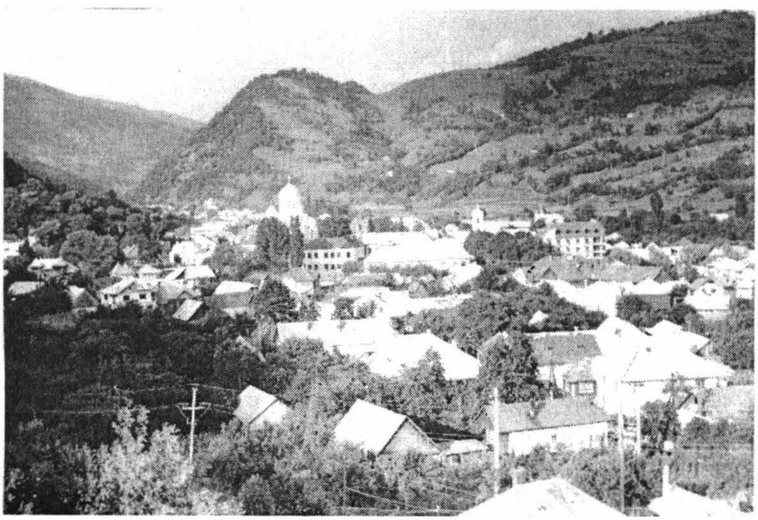


Fig. 2. The central nucleus of the Rodna settlement, which mostly superposes over the inital medieval habitat



Studii şi cercetări, Geologie-Geografie 10, 2005, Bistriţa, p. 147-150

CURRENT TENDENCIES IN OZONE RESEARCH

G.VÂJU*

Abstract. The author of this article, relying on his long activity in the research field of ozone production and its applications to industrial technologies, reviews the main interest directions in ozone research. In this article, there are succinctly reviewed several considerations meant to show the importance of ozone for the dynamics of social – economic life, a short historic and properties, the current research directions and development tendencies.
Key words: ozone, environment, pollution

Introduction

The ozone O_3 represents an allotropic state of the oxygen, its molecule consisting in 3 oxygen atoms. Ever since its discovery by Schönbein in 1840, the researches related to it have not lost interest up to the present. These researches have been very intensive over this relatively long period of time for several reasons that have successively occurred and were dominant during certain periods of time. As the chemical method is one of the obtaining methods, the ozone study pays its tribute to the chemistry researches from the acquaintance period, the pioneerdom, of the substance, molecule and atom structures.

As a powerful oxidant right after Fluorine, fluorides and atomic oxygen, [1-6] through this aspect the ozone related researches have been accelerated and diversified. Having a simple molecule with three identical atoms, along with the development of spectroscopy the ozone proved itself as an adequate element for the control of the atomic and molecular theories of quantum physics. At the same time, the studies in cold plasma from the Corona dischArgeş in air and oxygen respectively, once again had ozone as an element for study because it is a main reaction product. More recently, the successes in different industrial procedures have emphasized many of ozone's utilization both as main technology and as an alternative one, preferable according to some criteria [7].

Its stratospheric presence has maintained the interest upon this research object due to the unsuspected biological implications on the biosphere in general and on people in particular. The protective umbrella against the UV component of the cosmic radiation incidental on Earth, which is constituted by the ozone layer and has been seriously damaged within the past 10 years, makes the inter-disciplinary studies of ozone to permanently develop.

Last but not least, its presence as relentless pollution factor in different industrial areas holds as obligatory the permanent surveillance of its concentration [8]. This aspect allows the disciplines that that have environment pollution as study object to permanently develop environmental concentration measurement methods and to establish new standards for their unification with the purpose of information compatibility.

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Ozone in the atmosphere

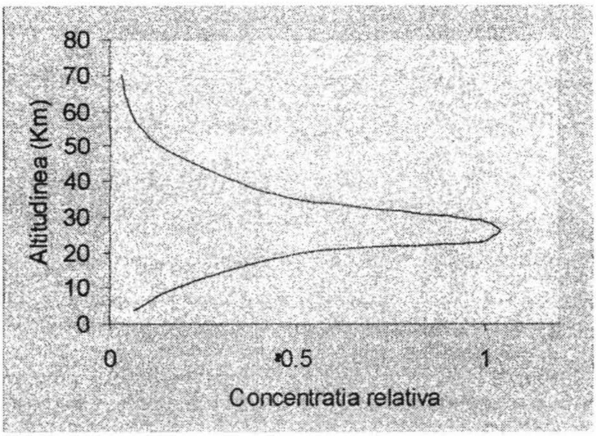
Ozone is formed in the upper layers of the atmosphere (20-40 Km) under the action of UV radiation with the wavelength of $\lambda = 200$ nm, that partially dissociate the oxygen molecules into free atoms. These ones will combine with undissociated oxygen molecules forming ozone.

$$O_2 + h = 2O$$

$$O + O_2 + M \rightarrow O_3 + M \ (H = -24 \text{ Kcal})$$

The distribution of the ozone layer around the planet [9] is given in Fig. 1.

Fig. 1.



The resulted ozone layer absorbs radiation in the UV domain, $\lambda \in [2000\ 4000\ A^0]$, partially decomposing into oxygen again:

$$O_2 + h\nu \rightarrow O_2 + O$$

$$O_2 + O \rightarrow O + 2O_2 \ (H = -93\text{KcalI})$$

Do to these mechanismes, the ozone layer acts like a filter to block the ultraviolet radiation which would prove very harmful for the fauna and vegetation provided they reached Earth.

The absorption of the UV radiation is made according to Beer law:

$$I = I_O e^{-kcl}$$

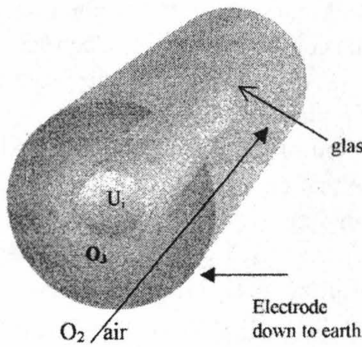
where the symbols stand for: c – the number of absorption molecules/cm and l – the length of the covered distance (cm) and k – the absorption coefficient.

Although the ozone layer, as seen in Fig. 1, has a variable concentration with great differences for different heights, it entirely absorbs the incidental UV radiation.

The industrial production

The industrial production is made today almost exclusively with Siemens equipment, which is a permanent object of study so as to increase both the ozone production per hour as well as its efficiency [10-11]. Fig. 2 gives the fundamental scheme of a discharge tube of cylindrical symmetry, used for equipping an ozone generator. The electric input in the generator can be made at the following tensions: high continuous positive or negative, alternative sinusoidal, alternative in rectangular impulses with different repletion factors and frequencies.

Fig. 2.

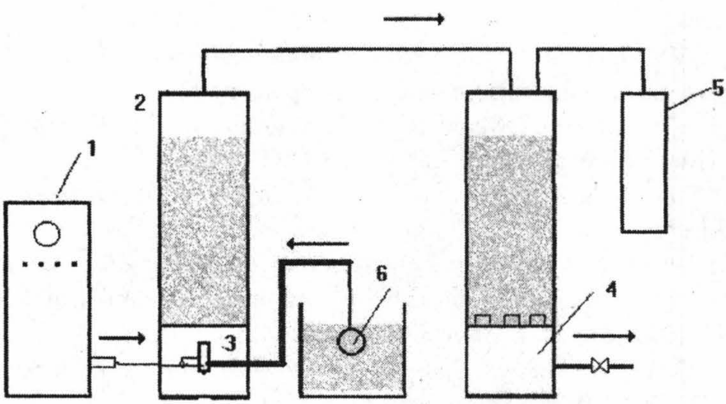


The application in water treatment

By far, the equipment of the highest productions are to be found in the field of potable water and the purge of residual waters from industrial processes. [12]

Fig. 3 shows the scheme of an installation for potable water used for field researches.

Fig. 3.



1. Ozone generator
2. Treatment tower made of a glass cylinder with PVC tightening flanges at both ends
3. Static means for dispersing of the ejector type
4. Filtering column with filter bed, quartz sand
5. Ozone destroyer
6. Centrifugal pump

Current interest directions in ozone research

The research of stratospheric ozone, the dynamics of the ozone layer, the factors to change its characteristics, namely its area and its thickness. SOFTWARE for the study of the plasma mechanisms, in the ozone generators.

Concentration measurement methods at a micro level, namely in the production volume, at the production devices exit, the residual ozone in the environment in which it was used.

Researches at the contact plasma surface and the components of the ozone generator, that is to say the warm electrode (tension electrode), cold electrode (nil electrode) respectively.

Researches to increase the efficiency of ozone production in high-production generators meant to optimize the functioning.

Studies for the development of the application field. Although it may seem very remote, in the field of ozone applications there can be included its use in different chain links of the life maintenance in space colonies. The author regards ozone as being indispensable in remote colonies as against Earth. It will be used to make potable water out of the worn-out water because of its advantages:

–It's locally produced and this way the transport stage is eliminated and only two components are necessary to produce it: oxygen and energy. The energy and the oxygen will have to exist in sufficient quantities in those communities, otherwise these projects will be nothing but mere Utopias.

Conclusions

The comprising scientific literature proves that ozone still focuses the researchers' interest in many fields.

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Studii şi cercetări, Geologie-Geografie 10, 2005, Bistriţa, p. 151-157

THE DIALOGUE BETWEEN VATICAN AND THE COMMUNIST COUNTRIES. GEOPOLITICAL ASPECTS

N. CEUCA*

Abstract: Vatican's importance as an international state does not derive from its territorial surface, which is about 44 hectares, but rather from its leader's prestige – -namely the Pontiff Sovereign. The beginning of the 20th century found the Roman Catholic Church is a static position, which did not allow its alignment at the dynamics of international relations, a good reason for Pope John XXIII decided to summon the 2nd Vatican Council, a self-standing one, having as purpose to „update" (aggiornare) the church. In this context, the importance of the decisions taken within 1962-1965 will have an impact on the Church's development on every scale, both in its relations with the other churches and in what concerns those with the states, whatever their political orientation might be. The geopolitical context during the „cold war" imposed a new politics meant to improve and to allow the cooperation with both sides, according to the Church, as it was its duty to take care of all its adepts.
Key words: Vatican, geopolitics, Christianity, communism.

The growth of Vatican's international influence made the Ministry of Foreign Affairs from Bucharest to ask the Embassy from Rome for a report that should analyze the opening manifested towards the communist countries.

The theoretical premises of this opening were presented by Vatican in two documents: The Pastoral Constitution „*Gaudium et spes*"(December 7, 1965) and the Encyclic „ *Pacem in terris*" (June 1963), the latest one expressing Pope's intentions to put the Church in public service in order to help at the consolidation of peace and unity among people. This opening of the Church surprised not only the communist states, but also the Orthodox Church, which assembled in Rhodos to establish the problems to be discussed, should a dialogue be initiated.

The opening politics initiated by Pope John XXIII (1958-1963) was mostly continued by the new Pope, Paul VI (1963-1978), and materialized in two encyclics: „*Ecclesiam suam*" (1964) and „*Populorum progressio*" (1967).

Nevertheless, Pope John XXIII holds the merit to have been the first one to desire the attainment of a unification of churches and a dialogue with the communist states, as it was during his reign that Vatican was visited by communist representatives such as Alexei Adjubei, son-in-law of the russian communist Hruschev, as well as representatives of the Orthodox Church. The document's author underlines that Adjubei's visit to Vatican took place in a moment when his father-in-law was „at the top of his power within the party and the state".

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It is presented as well a new attitude of Vatican, „more realistic one", by „reconsidering" its former positions. Pope Paul VI went in several journeys to Jerusalem, U.N.O., Spain and Bogota, showing his interest in economic, political and social problems, meant to ensure the accomplishment of a dialogue with the world, other than an ecclesiastic one, a dialogue „with the modern world".

The changes to take place within the Roman Catholic Church were regulated by the 2nd Vatican Council where there was a real fight between the two tendencies, the progressive and the conservative. The conservative ones pointed that it was not adequate for the Church to initiate a dialogue with the communists, in view of their atheist conveyance, especially that religion was persecuted in those countries, and most of all the catholic one, which had a centralized leadership represented by Vatican. More than 200 bishops and cardinals who participated at the council signed a declaration in which they requested the refusal of a dialogue with the atheism.

Eventually, the Catholic Church gives up certain principles representing an obstacle for the dialogue with the communist countries and the Orthodox Churches. A new politics had to be adopted, with reference to the geopolitical conditions, as the Orthodox Churches belonged mostly to communist countries that controlled and limited them on every scale. And what is more, the U.S.S.R. wanted to build an orthodox front to be leaded by Moscow, an initiative that was refused by the other Orthodox Churches.

The tendency of Church renewal adopted by Pope John XXIII brought along the appearance of new organisms or the reorientation of the existing ones. In 1960, the Secretariat for Christian Unity is created, having as a main goal the discussions with the other churches of the conditions under which they would agree to send observers at the 2nd Vatican Council. This happened during the period in which the Secretariat was leaded by cardinal Agostino Bea. After 1966, its activity is reoriented, having as task the development of a sustained ecumenical activity aimed to allow the initiation of a dialogue with the other Churches.

In 1964 was founded the Secretariat for non-Christians having Paolo Marella as president and the main target to develop a dialogue between the Roman Catholic Church and non-Christian religions such as islamism and mosaism.

Furthermore it is presented the Secretariat for non-believers, founded in 1965. Cardinal Francisc Konig, archbishop of Vienna was appointed as president of this organism. Initially, this Secretariat was named „for atheists", but over the insistences of President Tito, its name was changed. Another cause for its name changing was the large scale it was to address to, namely to also include in its activity the atheists who organized themselves as self-standing associations, apart from the ones in the communist states. Choosing cardinal Konig as leader of this organism proved the importance of the geopolitical context for Vatican. A bishop from a neutral state which had diplomatic relations with the communist states could better accomplish his mission, because his were supposed to have been more easily approved by the communist leaders, or he could be part of a diplomatic delegation as a state's representative.

Not only the president was widely famous as a specialist in religious history, but also his secretary Vincenzo Miano, dean of the Philosophy Faculty within the Salsian

University of Rome, who was well prepared in the Marxist doctrine, which allowed him to learnedly organize the fight against it.

The document's author considered that, by founding pre-council and post-council organisms, Vatican did not exhaust the problems for which the Secretariats were created. It is true, but there must be appreciated the will to change attitude towards the other religions and the communist countries and in this sense we can conclude that, following the opening created by the Council's decisions, Vatican realized that the situation could not be solved by a „cold war" attitude, but only through opening and dialogue acceptance from both parts.

An important problem was to define the term of „dialogue", which was understood in different ways by the two fractions from Vatican, the progressive and the conservative ones. In the conservative's opinion, a dialogue with the communists undoubtedly meant their acknowledgement, whereas the progressive regarded dialogue merely as a collaboration that helped finding coexistence ways. In order to learnedly fight for that cause, the dialogue needed to exist, even though it had to be between Christianity and atheism. No matter how many speculations we might make, we can not come with an idea to reveal a confluence between the two trends, but through dialogue they could reach coexistence, which was necessary given the historical conditions. The lack of this dialogue led to strong persecutions of the Christians from the communist states, regardless of their affiliation to Church.

It is presented the situation in Italy, where, in the author's opinion, the cooperation between Catholics and communists managed to overturn the rules of Christian democracy. The Italian government acknowledged the Popish state and allowed it to have an Apostolic Nuncio to defend the church's interests. From this perspective we can affirm that the occidental communist countries treated the Catholic Church in a different manner than those from the eastern countries where it was persecuted, thus the geographic position of the countries that were to uphold a dialogue being held as essential.

The author forwards the idea of an international dialogue, which means the cooperation between Vatican and the socialist countries, an idea that wasn't agreed by the representatives of the Roman Curia who recommended a „cold war" against communism, regarded as a persecutor of religion. Communism can properly regarded that way, as not only did it impose its own ideology by force in most of the countries, but it also considered religion, especially the Christian one, as an enemy, and it applied to radical measures to exterminate it. And still, the new geopolitical context could not ignore the large number of people living in the communist block, and that was the reason for the necessity of dialogue.

As a result of this reality, in the 2nd of October 1968, the Secretariat for non-believers elaborated a document – „The dialogue with non-believers", in which there was admitted the possibility of a dialogue between Catholics and communists, underlining at the same time that „dialogue is a reality that cannot be denied and must be cultivated". This characteristic makes it very important, as the first document to develop the possibility of dialogue between the Roman Catholic Church and communist states.

The analysis made by the Romanian representative together with the specifications issued by Cardinal Francisc Konig point to the theoretical aspect of that document. In other words, the author, who presents the document's analysis in a material sent to the Ministry of Foreign Affairs, advanced his opinion that the imposing of the „conditions and accomplishment standards, along with the distance manifested by its authors, make its content diminish". The document was published and largely analyzed in the occidental press.

The document presented two types of a possible dialogue between the two parties: the first one referring to „a meeting based on simple human relations so as to create an atmosphere of sympathy between the interlocutors", whereas the second one was referring to „a meeting meant to establish the conditions for a cooperation in view of determining the practical objectives in spite of the doctrinaire divergences".

The first part of the document pointed out that „dialogue implies a certain reciprocity, as each of the interlocutors is supposed to give and receive", this quality making it differ from polemics. This dialogue permits the analysis of the possibility and rightfulness on a doctrinaire field. The acceptance of the dialogue idea between the two implies certain elements to be discussed, this step itself representing a real gain. The document, as it was devised, agrees with the idea of a dialogue even between two parts having radically opposite conceptions, because „there's always a possibility of meeting and communication even between people divided by radical divergences. As affirmed in the document, this dialogue „implies major risks" but in spite of them, it is recommended, as long as its existence is possible. Starting from this idea, it was recommended a dialogue with anybody, as long as the rules were respected. All along, the dialogue was advised to be led on various themes, „accessible for the human sense". The recommended themes were philosophy, religion, ethics, history, politics, but artistic and cultural subjects as well.

In what follows, it is presented the existing difficulty in case of a dialogue with the communists because for them, there was a tight bond „between theory and practice". In reality, it is known that there was, at least in Romania's case, a great difference between theory and practice or between theory and reality. Provided it's true that theory and practice are close to each-other, then at least in what concerns religious belief and church there were not so many obstacles and the examples might go on. On a theoretical level, one can talk about a resemblance, which can create confusions and burdens in case of a dialogue, transforming it from a doctrinaire one to a practical one, which was impossible and void with the communists. The simple doctrinaire dialogue on mutual subjects would have been a step forward, at least for Romania, as it refused any kind of official dialogue with Vatican.

So as to avoid suspicions of that kind, it was best for the two parts to clearly establish from the very beginning the sense of the terms to be used, thus leaving apart any ambiguity. Provided those conditions were respected, the dialogue between the two parts would have been a fair one or at least the most elementary rules of a dialogue would have been followed.

After these specifications regarding the doctrinaire dialogue there were announced the conditions of „a dialogue on the action level". This could be established between „persons, groups or communities of different or even opposite orientations". Furthermore, there are presented some specifications to be accounted on if the dialogue was to be made with doctrines contrary to Christianity, as „sometimes the dialogue may evolve towards positions that are not necessary joint with the departing ones". This is the reason of the urge that the interlocutors „should be competent individuals", and the terms of the dialogue to be set at its beginning.

Despite of those difficulties, it was specified that „the global divergences" should not exclude dialogue, on the contrary, they must encourage it, as these divergences between systems do not exclude „partial ones", through which certain values could affirm. Of these partial divergences one might take advantage especially when it comes to a religious dialogue, where collective elements can be discovered and can lead to a real dialogue, as in the case of Orthodox and Roman Catholic Churches; after the Council there is an increased practical dialogue, very useful in the perspective of the meetings to follow. One must acknowledge that the religious divergences do not exclude convergence, but they refer only to temporary situations.

The document goes on making distinction between the public and the private dialogue, for the last mentioned being indicated a series of exigencies, namely „prudence" ones. They come to help the catholic believer who, if feeling unprepared over such a dialogue, can appeal to competent persons with the purpose of guarding him against doctrinaire mistakes, as well as protecting him from uttering suppositions that are contrary to elementary ethics. Through this relation with competent persons, the Church's opinion related to certain concrete problems could be known.

The public dialogue brings along a greater prudence, given the repercussions that might follow some agreements, especially on public opinion. Two types of dialogue are useful in this sense, namely the public one and the official public one, which requires special agreements from the ecclesiastic authority and it „very seldom occurs due to the conditions that need to be fulfilled".

The written dialogue is the latest one to be dealt with in the document. This type of dialogue is accomplished through certain magazines or publications. An emphasis was made on the care that was to be taken by those who wrote, but on the other hand, this type of dialogue „offered the biggest guaranties", especially in what concerned the content of materials to be written, as they were supervised by competent persons before being published. This was meant to avoid improvisations and doctrinaire mistakes as well, which was very important for the Church.

After presenting the document, cardinal Konig and other Vatican officials brought new specifications regarding above all a possible dialogue between Catholics and communists. As for the latest ones, cardinal Konig pointed out that a dialogue between Catholics and the atheist communists was not possible at that time, whereas concerning the non-communist atheists, he affirmed that „a cooperation on a political level was officially possible".

By these latest remarks there was made a clear distinction between the two categories of atheists, based on their dwelling geographical area. The communist atheists were geographically identified with the communist countries with which Vatican could not develop a dialogue, because even the political conditions did not allow that, not to mention the existing difference between believers and non-believers. There could be a dialogue with the non-communist atheists, even though not a doctrinaire one, as the discussions could be on social and political subjects and this way it could end up to a better knowledge of the two parts' ideas, at least in what concerned problems of a general character.

Next, the author refers to the way in which the document was regarded by the international press and about the reaction of the communists in Western Europe.

It is presented the reaction of the Italian Communist Party and of the socialist paper „*Avanti*". At first, the document made sensation and was considered as a starting point for the dialogue between Vatican and the communist countries. In Italy, for example, the communist newspapers and publications presented the document in extraordinary terms, because they were surprised by the novelty of an even theoretical dialogue acceptance, after it had been denied for several decades. At the same time, the communist newspapers made references to the divergence of opinions existing between the Italian Christian Democratic Party and Vatican in what concerned the idea of a dialogue of that kind. Conversely, the Italian Communist Party, through its ideological organ and referring to this problem, underlined in the 11^{th} of October that „dialogue in Italy essentially became confrontation and common search between communists and Catholics as a moment of unitary synthesis, giving the actual dimension that had become evident for a long time but had not been solved until then". By this idea the communists considered dialogue as necessary, forgetting that only late did Vatican politically acknowledged them, and for a dialogue to exist, the two parts involved had to mutually acknowledge each-other. By this acceptance of dialogue, Vatican tacitly acknowledged the communist countries.

As for the possible dialogue between communists and Catholics on an international scale, the socialist daily newspaper stated that „it is necessary for the communist states and The Holy Chair to freely define their relations". Discussions can be made on a certain freedom of the western communist governments, but not on the freedom to adopt their own foreign politics for the eastern ones. For the occidental ones, Moscow's influence was diminished by the fact that there was an opposition, and the government, even though a communist one, did not consist of a single party. These two political poles were on the one hand diminishing the force of the communism, and on the other hand Moscow's influence. The situation in Eastern Europe was different though. The ruling communist parties destroyed the opposition, which allowed them to rule however they wanted, and Moscow's influence was major.

To conclude, we can say that during the 60's, geopolitics decisively influences the international relations. Two blocks had already been formed, the capitalist and the communist ones, each one willing to gain a greater international influence and holding the values the believed in as being the true ones. In this context, Vatican represented not only the Catholic world's political power, but also the religious one, and for that reason it had to make sustained efforts to help more its adepts from beyond the iron curtain. These efforts materialize in several official documents elaborated with communist states beginning with 1964, thus opening the possibility of a dialogue with the other ones by adopting a document to specify the conditions of a real dialogue. This document was received in different ways by the communists, namely accepted by the occidental ones and rejected by the eastern ones. Nevertheless, its importance on an international scale was accepted, as it came to establish the future of the relations between the interlocutors and their development manner.

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Editura SUPERGRAPH
ISSN 1582-5167