FORMATION AND EVOLUTION OF THE DANUBE DELTA

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ABSTRACT: The Danube Delta is the newest territory of Romania. Its formation took place in several stages, from Paleozoic to Pliocene. During this time, six geological cycles were highlighted. The most important stage in the formation of the Danube Delta is the Deltaic stage because no orogenic movements have taken place, erosion due to the winds and precipitation has taken place and the main cracks have formed. Around these beams the floods brought by the Danube river accumulated, which led to the formation of the current delta.

Keywords: Danube Delta; geology; cycles; stages; levees; sediments; clogging;

The formation of the Danube Delta meant that several conditions were met to justify its current configuration. Initially, there had to be a limanic-type (triangular-shaped) bay, during which the depth of the head is made gradually (up to 180-200 m over a distance of 180 km), tides with small amplitude that do not contribute significantly to the process. sediment removal (9-11) cm. The coastal currents and the transport of sedimentary material that they make, resulted in the gathering of an important amount of alluvium brought by the Danube [6] (fig. 1).

All these genetic factors have blended, happily we could say, over the last ten thousand years and have resulted in the creation of the Danube Delta.

The Danube Delta is based on geological formations belonging to the Predoborgean Depression, which was formed during six sedimentation cycles (fig. 2):

- *The Paleozoic (pre-Mesozoic) cycle*, with a limestone or dolomitic specificity;
- *Lower Triassic cycle* with thicknesses of 400-2500 m with red detritic continental deposits, having intercalations with effusive rocks;
- Transgressive marine middle and upper triassic cycle, consisting of carbonate

rocks in the lower part and in the upper part of detritic rocks;

- *The Jurassic cycle*, marine transgressive, constituted like the previous cycle, from detritic material at the base and carbonate rocks at the top;
- *Cretaceous cycle* consisting of red detritic material, of continental origin, with variable thicknesses of the order of 500 m;
- *The Sarmatian/Pliocene cycle* consisting of clay deposits, sands and sandstone with thicknesses of 200-350 m.

In the formation of the Danube Delta, two stages can be distinguished: the pre-deltaic stage and the deltaic stage.

The predelataic stage is placed, from the point of view of the geological time, in the Pleistocene and is marked by changes imposed by the climatic changes (alternation of glacial phases with heating phases). Characteristic of this stage are the loessoid deposits that are in the substrate of Letea and Caraorman beams [6].

The deltaic stage is the stage where the territory is no longer immersed, even its erosion due to exposure to exogenous agents (winds, precipitation, etc.) - about 18,000 - 15,000 years before the current stage.



Fig. 1. The stages of formation of the Danube Delta 1. The golf phase (about 10,000 years BC), 2. The lagoon phase (9000-10000 years BC), 3. The Saint George phase (9000-7200 years), 4 Sulina phase (7200-2000 years BC), 5. Sfântul Gheorghe II ş i Chilia. Map of surface deposits (2000 years BC - present)

| Γ | CUA | ATERNAR | Nisipuri, pietrișuri și argile cu faună salmastră, argilă roșu-cărămizie |
|------------------------|----------|-------------------------------------|---|
| ROMANIAN | | | Nisipuri și argile cu Viviparus bifarcinatus, Dreissena polymorpha |
| DACIAN | | | Nisipuri și pietrișuri cu Stylodacna orientalis |
| PONTIAN | | | Argile gri și nisipuri cu Caladacna steindachneri și Dreissena sp. |
| MEOTIAN | | | Nisipuri roșietice și argile cu Dosinia maeotica |
| SARMATIAN | | | Nisipuri, argile siltice, calcar bioconstruit cu Clavifera triplex |
| CRETACIC | | | Argile, dolomite și dolomite gipsifere cu Clavifera triplex |
| JURASIC | SUP. | | Calcare și marne cu Textularia jurassica și Spirilina orbiculata |
| | F. MEDIU | | Depozite fine cu intercalații de argile cu: Bositra buchi, Nonnoceatopsis spiculata, Pareocardinia ceratofora |
| TRIASIC | SUP. IN | Formațiunea Caraorman 450 m | Argile calcaroase și silturi cu: Limbosporites lundbaldi, Ovalipolia ovalis |
| | MEDIU | Formațiunea Obretin 1000 m | Argile și argile dolomitice cu: Gondolella navicula, Thiradispora crassa |
| | INF. | Formațiunea Lacul Roșu 1500 m | Gresii roșii și argile, bazalte, riolite, conglomerate cu: Taeniosporites navicularis, Falcisporites zapfei |
| DEVONIAN ? SILURIAN | | VONIAN LURIAN | Nisipuri mâloase și depozite calcaroase |

Fig. 2. Stratigraphic column of the Danube Delta foundation (after Mutihac & Mutihac, 2010)

Letea and Caraorman beams formed erosion witnesses that preserved deposits dating from the Upper Pleistocene.

A particularly important role in the evolution of the Danube Delta is the formation of the "initial cordon Letea-Ceamurlia-Caraorman", which took place between 11,700-7,500 years ago. Hr (Panin, n., 1974, 1983, 1989). The coastal cordon was fed with debris material transported by the sea currents from the area of the Dniester, Bug and Dniper rivers. After the formation of this natural barrier,

the accumulations of sediments continued and led to the Danube's clogging and modification of its flow.

The oldest arm of the Danube is Sfântul Gheorghe which, due to the clogging, considerably reduced its capacity for taking over the waters, which led to their migration to the north and the formation of a new arm, Sulina. This process had consequences in the delta's morphology by generating a so-called secondary delta around this new arm. Similarly, the appearance of the Chilia arm occurred [6] (fig. 2, 3).



Fig. 3. The evolution stages of the Danube Delta (Panin et al., 2003-2004)



Fig. 4. Map of surface geological deposits of the Danube Delta (after Romanescu, 2013, with additions)

The Danube Delta is made up of debris deposits with variable thicknesses up to 400 m. In most cases there is a "fining-up" type deposit, which presents sandy deposits, sometimes coarse deposits, reaching to gravel. Towards the top, the size of the fraction decreases to the slopes. The arrangement is not strict, with the climatic variations there have also appeared intercalations that complicate the storage and flow of aquifers in the area [12](fig. 3).

The foundation of the Danube Delta consists of deposits belonging to the Scythian Platform over which the deposits of the Predobrogean Depression overlap, their lithological succession can be seen in fig.1.

The beams represent forms of relief composed of coastal and / or fluvial deposits of older age (examples: Caraorman, Letea, Sărăturile, Chituc, etc.). The debris material from which they are formed has two main sources: a part was brought by the coastal marine currents and is represented by a quartziferous sand (89-95% SiO2) sediments taken from the mouths of the Dnieper rivers, the Bug de Above and Nistru and another part is represented by a slightly finer and richer fraction in heavy minerals (2-3%) that was transported by the Danube[6].

In the beams, the sands have small-scale oblique lamination, grooves and vegetal debris [2].

The area distribution of the different types of geological deposits is shown in fig.4. The Sfânul Gheorghe fault separates the Delta from the North-dobrogean Orogen [1, 13].

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