MINERAL COMPOSITION OF UPPER-MIOCENE-PLIOCENE (PANNONIAN S. L.) SANDS AND SANDSTONES IN THE DIFFERENT SEDIMENTARY SUBBASINS IN HUNGARY

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Abstract: Taking into account the frequency of different detrital minerals in sands and sandstones of different areas, based on mineralogical data from microscopic examinations, the paper tries to compare and to reconstruct the transport directions into the different subbasins of the Pannonian basin and to get information about the rocks of the source areas.

Key words: Pannonian basin, Upper-Miocene, Pliocene, sedimentary rocks, mineral composition

The mineral composition of more than 2900 Upper-Miocene-Pliocene (Pannonian s. l.) sand and sandstone samples from boreholes and outcrops in Hungary are known from earlier examinations by petrographic microscope. The minerals were quantified by point counting mainly in the 0.1-0.2 mm fraction of the samples. Most of these mineralogical data were collected by SALLAY (1984). There are some statistical evaluations of the data in THAMÓNÉ BOZSÓ (1997).

We studied the different sedimentary subbasins by comparison of mineralogical data of their sediments.

Geological and paleogeographical sketch of the basin

The Upper-Miocene – Pliocene (Pannonian s.l.) sedimentary sequence was deposited in the brackish water Pannonian lake while emerging of the Alpian–Carpathian orogen system occured in the surrounding areas. The thickness of the sedimentary succession can exceed 4000 meter in the deepest parts of the subbasins. The main subbasins are the Jaszsag-basin, the Derecske–trough, the Bekes–basin and the Mako-Hodmezovasarhely-trough in the Hungarian Plain, as well as the Danube–basin, the Zala–basin and the Drava–basin in Transdanubia . The geological setup of the different subbasins were investigated by many authors. General conclusions were drawn up as on the seismic stratigraphic part by Gy. Pogácsás et al., as for the sedimentology and lithostratigraphy by Gy. Juhasz, as for the sequence stratigraphy by G. Vakarcs et al., as well as on the biostratigraphical part by P. Muller and I. Magyar in several works.

After the thermal subsidence, sedimentation occured in a deep basin by settling hemipelagic sediments in the deepest and farthest part of the basinal areas. Progradation of the shoreline produced a thick sedimentary sequence as the emerging areas from the hinterland served tremendous amount of siliciclatic sediments carried by large rivers into the basin. The main rivers formed large delta systems on the NW and NE margins of the lake as these were the main transport directions for the Hungarian part of the basin. Smaller rivers arrived also from other directions all around the lake.

Therefore a sedimentary sequence of shallowing upward can be found in the basin, where the hemipelagic basinal marls are overlain by a thick (0–1000 m) deep–basin turbidite succession pinching out towards the marginal areas. Above the turbidites a shaly sequence of basin and delta slope unit of a considerable thickness can be traced over the whole basin which gives the best evidence of the transport directions for the different parts of the basin. Generally it can reach several hundred meters which refers to the water depth as well. The slope lithofacies unit is overlain by a thick littoral unit comprising mainly the delta front and delta plain sediments. Its thickness is rather big, generally 3-400 m, but can reach 1000 m in some zones. After the infilling of the basin a thick fluvial succession deposited overlying the littoral unit during Upper-Miocene – Pliocene times. The different lithofacial units therefore form time-transgressive units becoming younger towards the SE part of the Hungarian part of the basin where the last remnant of the lake was found (Juhasz Gy.1994).

General mineralogical characteristics of the sedimentary succession

On the bases of the evaluated mineralogical data, most of the Upper-Miocene-Pliocene sands and sandstones in Hungary are subarkoses, and some quartz sandstones. Arkoses and other petrographical types also occur among them. They have higher heavy mineral content and they are more mature than the older Miocene sandstones, on the other hand they have lower heavy mineral content and they are less mature than the Pleistocene sands in this area. The characteristic minerals of the Upper-Miocene-Pliocene sands and sandstones are the micas, mainly chlorite and muscovite, which are more frequent in these sediments, than in the younger and older Cenozoic sedimentary rocks. While rock fragments, garnet, magnetite, amphibole and pyroxene are relatively rare in the studied sandstones.

We reconstructed the plate tectonical position of the provenance of these sands and sandstones on the basis of their quartz, feldspar and rock fragment composition, using Q-F-L diagram of DICKINSON & SUCZEK (1979). Most of the studied sandstones derived from recycled orogen and from continental block, and some originated from magmatic arc.

Main transport directions in the different subbasins

Taking into account the frequency of different detrital minerals in sands and sandstones of different areas, we tried to reconstruct the transport directions, and we got information about the rocks of the source areas.

In the **Jászság basin** the transport directions of the garnet and epidote rich sediments were NW and N. These were originated mainly from metamorphic rocks of the Western-Carpathians, and their quartz, feldspar, rock fragment, biotite and ilmenite content was partly from the denudation of volcanic rocks of nearer northern directions.

In the **Derecske trough** most of the amphibole, magnetite, garnet, biotite and pyroxene rich sediments were originated from NE direction, from the denudation of the Inner Carpathian volcanites. Some of the minerals (garnet, biotite, chlorite, tourmaline, staurolite, zircon, epidote, kyanite and zoizite), however, came from other source rocks from different directions.

In the **Békés basin** sediments seem to have a mixed origin corresponding fully to the seismic stratigraphic and sedimentologic results. Sands and sandstones have high feldspar, chlorite, garnet, magnetite, amphibole, epidote, biotite and tourmaline content, these onesmainly originated from the east (Apuseni Mountains ?). Some minerals (feldspar, pyroxene, amphibole and biotite) derived from the NE direction, from the Inner Carpathian volcanites while others (chlorite, kyanite, zoizite) from the NW direction.

In the **Makó-Hódmezõvásárhely trough** the sediments with relatively high feldspar, muscovite, chlorite, garnet, epidote and amphibole content, derived mostly from the NW direction from metamorphic rocks, but the frequency of some minerals reflects a SE transport direction (Apuseni Mountains and/or Dinarids?).

In the **Kisalföld basin** the sands and sandstones have relatively high feldspar, muscovite, chlorite, garnet, epidote, biotite, amphibole and tourmaline content, and kyanite, zoisite, staurolite and sillimanite are medium frequent in them, so they could originate mainly from metamorphic source area.

The samples of **Zala basin** are scattered and derive only from the marginal areas: we had only outcrop data. In the sediments, the amphibole, garnet, kyanite, tourmaline, staurolite and corundum are more frequent than in the samples of the surrounding areas. These minerals, partly derived from metamorphic rocks, were different from the metamorphic source rocks of sands in other basins. it is probably due to the western transport direction into the basin besides the NW one. We had no valuable data from the Drava-basin.

In the course of the analysis of the mineral composition of the sediments, the effect of the components of the metamorphic and volcanic rocks of the surrounding areas seems to be dominant while the recycling of older sedimentary rocks (like the flysch and the molass) had important role in the Upper-Miocene-Pliocene sedimentation as well.

In order to check our conclusions about the source rocks, we calculated the *amount of the metamorphic heavy minerals*. It is the highest in the sediments of the Makó-Hódmezõvásárhely trough and the Kisalföld basin, lower in the Jászság and Békés basin, and the sands and sandstones have the lowest metamorphic heavy mineral content in the Zala basin and Derecske trough.

To compare the mineral composition of samples from different basins with each other and with the surrounding areas, we also applied *cluster analysis*. Cluster analysis, based on the detrital heavy mineral composition of samples, gave information about the provenance of the sediments, because the sands and sandstones within the same cluster have similar detrital heavy mineral composition, so probable they had similar source rocks. According to the cluster analysis, most of the studied basins' sediments belong to the same cluster. Among them sands and sandstones in the Jászság basin, the Makó-Hódmezõvásárhely trough and the Kisalföld basin are more similar to each other. It is, because they have high and similar metamorphic mineral content, and probably they have similar source rocks in the Western Carpathians. The sediments in the Derecske trough and the Békés basin are similar to each other, and they are different from the other basins, because most of their detrital heavy minerals were originated from similar source rocks of the Inner Carpathian volcanites.

Future perspectives

Our results, based on mineralogical data from microscopic examinations of sands and sandstones help to compare the main sedimentary basins, and help to reconstruct more exactly the Upper-Miocene-Pliocene (Pannonian s. l.) paleogeography of this area. In the near future we plan a more detailed study of the mineral characteristics of the different lithofacies units settled in particular time ranges.

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