

## Isotopic Indicators of Subduction Process in South Urals (Russia)

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The tectonic evolution of Urals palaeostructure went through the initial rifting stage (drift-related lower Ordovician sediments and lava), and then was transformed into oceanic basin with sea-floor spreading activity (sheeted dykes and pillow lava) and structural areas of island-arc magmatism produced Silurian-middle Devonian basalt-andesite-rhyodacite lava and tuffs, polymictic epiclastites, cherts and carbonaceous shells (Savelieva, 1997). From the late Devonian to early Carboniferous, the continental margins came in contact ("soft collision"). The second stage ('rigid' collision) is dated as mid-Carboniferous-late Permian and produced intense stacking of thrust sheets and growth of the Uralian fold belt. The Pb and Re/Os isotopic analysis of sulphide ore have been carried out in BRGM and IPGP (France) and compared with K/Ar for the sericite from metasomatic rocks. The isotopic composition of galena and massive ore from several VMS deposits has been determined. The points of analyses in the diagram  $^{206}\text{Pb}/^{204}\text{Pb}$  -  $^{207}\text{Pb}/^{204}\text{Pb}$  are located not far from single-stage curve. But the single-stage model is not acceptable for this case because there are different values for the same deposit and the model age does not correspond to the geological age. The age of Pb separation from U-Th system have been calculated according to two-stage model (Stacey and Kramers, 1975). Three main periods have been distinguished: Riphean-Cambrian (1), Devonian (2) and (3) Permian. The interesting fact is that the same deposit can be present in some fields - 1, 2 and 3 for Uchaly deposit; 1 and 3 for Alexandrinka deposit etc. 1) The Riphean-Cambrian age corresponds to the age of the Pb-Zn deposits, which are located in the Bashkirskiy anticlinorij - the relic of platform situated in the western margin of Ural structure. The continental blocks under the island-arc were reconstructed from geophysical data in Baymak-Buribay zone, where there are 2 deposits (Balta-Tau and Tash-Tau) with "old" lead. The lead can be leached not only from the Devonian volcanic rocks but also from the continental Riphean sediments with Pb-Zn mineralization. In the result we have an "intermediate" isotopic composition of lead. The interesting fact is that the "oldest" lead is more characteristic for the polymetallic Pb-Zn-deposits of "Kuroko" type. 2) Devonian age corresponds to the massive sulphide deposits formation. 3) Permian is the age of the "rigid" collision "continent - Urals

structure". Probably, the collision was accompanied by hydrothermal process. There are the latest veins with galena, which cut the sulphide ore.

Theoretically, Re/Os method allows to determine the age of VMS deposits formation. The isochron line was obtained only for Dergamish deposit situated in Main Uralian Fault ophiolite complex (Gannoun and al., 2000). The Devonian age ( $364\pm 10$  My) is different for supposed Silurian geological age and probably corresponds to first stage of the collision "continent - Urals structure". The pseudo-isochrone with the age  $300\pm 30$  My was obtained also for Alexandrinskoe deposit and corresponds to the first stage of the collision.

Potassium-argon method of age determination was applied for the sericite from metasomatic rocks (Mednokolchedannie..., 1992). But the age of sericite indicates not only the time of ore-formation, but also the stages of the transformation of Urals VMS and their metasomatic rocks. There are some stages of deposition of sericites: Ordovician (Novo-Shemurskoe deposit), Devonian: (360 - 390 My for 3 deposits). The stages of transformation of the sericites are correlated with the accretionary processes during the formation of Urals mounting - 13 deposits were transformed in Carboniferous-early Permian (288-347 My). The age of Alexandrinka sericite corresponds to the Re/Os age of ore.

Conclusions - 1) there are some stages of mineralization in the Urals VMS deposits; 2) the stages of mineralization probably correspond to the tectonic events due to subduction process in Urals paleoceanic structure.

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Gannoun A & al., *RST-2000*, (2000).

Savelieva GN & al., *Tectonophysics*, **276**, 117-137, (1997).

Stacey JS & Kramers JD, *Earth Planet. Sci. Letters*, **26**, 207-221, (1975).