Biogeochemistry of the Big Toroki sapropel lake, Western Siberia

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We investigated a 1.8 m long sediment core of Lake Big Toroki (N 55º 24', E 80º 36'). The lake has a closed basin of 9.57 km^2 in area and a 1 m in depth and is overgrown by macrophytes [1]. Its water is low-mineralized (845 mg/l), and belongs to the hydrocarbonate Na-Mg class according to [2]. The sediments are organic-mineral sapropels (C_{org} 45.4 %) according to [3]. Water macrophytes are the main producers of the organic matter. The sediment sequence consists of a substrate, bluish-gray sandy silts (180–160 cm), blackish peat (160–120 cm), coarse peaty sapropel with abundant mollusk shells (129–122 cm), blackish peaty sapropel with random gastropod shells (120–75 cm) and greenish macrophytic sapropel with random bivalve shells (75–0 cm).

Total organics, C_{org} and carbonates vary along the core in compliance with its sediment units. Total organics is 40–50% in the sapropel, 60–61% in 120–130 cm and sharply declines below 140 cm. C_{org} is 14–18% in 0–70 and 120-135 cm intervals, 9–13% in the middle and sharply declines from 6.4 to 0.47 % in 140–180 cm interval. Carbonates are low, 3–4 %, in the upper 0–75 cm and progressively increases to 14–16 % below.

The sediment pore waters showed variations in Fe, Mn, Cu, Zn, Pb and Cd. Sharp peaks of Fe and Mn are in the lower middle (90–130 cm), Cu, Zn and Cd in the upper middle (60–80 cm) and Pb in the top (0–40 cm) parts of the core. Changes of H, N and S, which mostly compose the organic matter, match variations of C_{org}.

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What causes the rapid change of Cenozoic magma sources in the Pamir?

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The Pamir mountains, building the western elongation of the Tibet plateau, were formed by the India-Asia collision ~55 Ma ago. Extreme shortening resulted in extremely thickened crust making the Pamir an ideal natural laboratory to study crustal melting processes.

After the India-Asia collision, post-collisional granitoids appear at ~46 Ma and the magmatic activity in the Pamir was rather sparse until ~33 Ma. During this time, Sr- and Nd-isotope compositions (initial $^{87}Sr/^{86}Sr$: 0.7223 to 0.7067 and initial εNd: -10.3 to -2.6) indicate a gradually increasing amount of mantle components, coupled with decreasing SiO_2 contents (77 to 62 wt.%). At ~29 Ma, this trend reverses with an increasing crustal component up to ~14 Ma; initial $^{87}Sr/^{86}Sr$ compositions increase again from 0.7064 to 0.7203 and initial εNd decrease from -3.7 to -8.4. Apart from these highly evolved granitoids, basaltic magmatism occurred contemporaneously. The youngest samples at ~11 Ma from the easternmost region of the Central Pamirs are ultrapotassic tephrites to tephriphonolites, showing some of the least radiogenic Nd isotopic compositions (initial εNd: -9.6 to -12.3) together with rather radiogenic Sr isotope compositions (initial $^{87}Sr/^{86}Sr$: 0.7100-0.7104).

What triggers the variable proportions of mantle and crustal components in the the sources of Cenozoic igneous rocks over such short time intervals? The post-collisional magmatism in the Tibetan Plateau is supposed to be influenced by a slab break-off at 55-40 Ma [1], leading to the ascent of asthenospheric material, thus triggering partial melting in the ascending mantle and the lower crust. Such a scenario provides a viable explanation for the increasing amount of mantle component in the 46-33 Ma igneous suites of the Pamir. The ongoing (crustal) shortening led to an extremely thick crust, in which anatexis caused the 29-14 Ma magmatism. Moreover, the subducting cold Indian slab interrupted the asthenospheric upwelling. We will further test this genetic model by combined Lu-Hf and U-Pb measurements on igneous zircons.

[1] e.g. Kohn and Parkinson, 2002, Geology, *30*, 591-594

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