Primary alkali kimberlite melt: The myth dispelled

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After decades of studies, the composition of the primary kimberlite melt is still poorly constrained. One of the models for the kimberlite origin suggests the melt is low in H_2O and high in alkalies, as observed in the "uniquely fresh" Udachnaya East kimberlite. Papers that proposed the alkali-rich affinity for the melt focused on geochemical evidence and did not report petrography or geology of the rocks, which are critically important for the geochemical interpretation. We present geological, petrographic and geochemical evidence that the alkali-rich affinity of the Udachnaya kimberlite and other kimberlites in Southern Yakutia relates to crustal contamination. Alkali carbonates, sodalite, gypsum, anhydrite, halite and sylvite are present in the groundmass and matrix of the Udachnaya, Mir and International'naya pipes (southern Yakutia). The kimberlites were emplaced through 2 km-thick evaporite-bearing carbonate sediments saturated with brines. In the global context, southern Yakutian kimberlites are unprecedented in the amount of the crustal carbonate and evaporite material included in the pipes. The secondary, crustal origin of Na, K, Cl and S-rich minerals is supported by the following: 1. A regional correlation between the geology and hydrogeology of the local country rocks and the kimberlite mineralogy, in particular the difference between southern and northern Yakutian kimberlites; 2. A restriction of halite or gypsum mineralization in the Mir and International'naya pipes to depths where pipes intersect country rock strata with the similar mineralogy; 3. The localization of the highest abundances of Na-K-Cl-S-bearing minerals in the Udachnaya East kimberlite at a depth interval that correlates across three magmatic phases of kimberlites and coincides with the roof of the halite-bearing country rock and an aquifer carrying anomalously Na-rich brines; 4. The presence of evaporite xenoliths and veins of halite, gypsum and carbonate cutting through the kimberlite and xenoliths; 5. The geochemical and Sr, C, O, Cl and S isotopic evidence for crustal contamination. Addition of crustal salts to kimberlite melt began prior to the volcanic fragmentation as a result of preferential melting and assimilation of evaporite xenoliths and may have continued in-situ after the pipe emplacement via reactions with external saline fluids. The hybrid, alkali-, S- and Cl-rich compositions of residual melts and fluids were trapped in secondary inclusions in olivine. Alkali-rich compositions of fluids trapped in fibrous diamonds shortly febore the kimberlite emplacement cannot support the model of the alkali-rich primary kimberlite melt, as the latter is significantly more Ca-, Na-, B-, and S-rich than the K- and Ba-rich fluid inclusions.

Composition of hydrocarbon source rocks of the Hayrettin Formation (Denizli/Western Turkey): Provenance, source weathering and tectonic setting

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The geochemical composition of the Oligocene hydrocarbon source rocks of the Hayrettin Formation of Denizli (Western Turkey) province were analyzed for major and selected trace elements to infer their provenance, intensity of palaeoweathering of the source rocks and tectonic setting. Total organic carbon (Corg, %) contents of organic matter rich rocks are between 0.21 % and 39.61 %. Plots of organic matter rich rocks on Al_2O_3 wt.% versus TiO_2 wt.% diagram and discriminant functions diagram indicate that the samples plot between the granodiorite and gabbro field, and quartzose sedimentary and mafic igneous rocks constitute the source rocks in the provenance. To constrain the climatic condition during sedimentation of organic matter rich rocks on SiO_2 wt.% versus (Al_2O_3+K_2O+Na_2O) wt.% diagram the samples plot in the field of semiarid climate. Plots of samples on bivariate discriminant function diagram reveal an active continental margin setting for the provenance. The chemical index of alteration (CIA) monitors the progressive alteration of plagioclase and potassium feldspars to clay minerals. CIA values for the Oligocene Hayrettin Formation organic matter rich samples vary from 26 to 81 with an average 70 indicating significant weathering at the source areas.

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