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UHP gneisses of the Kockhetav complex are sources for proto-shoshonite melts

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Collision belts often contain potassium-rich igneous rock, which can occur as both intrusions and volcanic sequences (shoshonitic series) that are characterized by high of trace element contents (most commonly LREE, Th and U) and strong crustal isotopic signatures (Nd, Sr, Pb). The formation of shoshonite melts in collisional setting is commonly attributed to low degree partial melting of mantle that had previously been metasomatized by fluids/melts derived from subducted crust. However this model has been recently challenged. The ultrapotassic shoshonite series in Eastern Tibet (China) range in composition from felsic dacites to ultramafic rocks. Campbell et al. (2014) explained the felsic members of this series by high degree partial melting of crustal rocks at high-temperature and pressure, and the mafic–ultramafic members by reaction of these felsic melts with mantle peridotite.

The Kokchetav UHP complex in Kazakhstan is famous for its occurrence of rocks that have experienced metamorphism within diamond stability field at a pressure over 45 kbar and a temperature of 950-1000°C. The most widespread lithology in the Kokchetav is metasedimentary garnet-biotite gneisses. The gneisses are characterized by strong depletion in LREE, Th and U, loss of K2O, compatible behaviour of HREE, Ti, Fe and Mg and large fractionation of both Nb and Ta. The trace element characteristics of the melt inclusions from gneisses demonstrate that these features are due to high degree partial melting and extraction of granitic melts with high abundances of LREE, Th and U. The residual assemblage contained garnet, coesite, ±phengite, ±clinopyroxene but not monazite, which dissolved into the partial melts.

The depletion patterns of the Kokchetav UHP gneisses are complementary to the enrichment patterns in shoshonites. Furthermore the compositions of melt inclusions in the gneisses are remarkable similar to those of the felsic members of shoshonite suite studied by Campbell et al. (2014). Therefore we propose that the UHP restites of the Kokchetav complex are the compliment to proto-shoshonite melts. These melts interact with olivine and orthopyroxene as they rise through the mantle, acquiring Mg, Fe, Ni and Cr as they do so but preserving their original "continental crust" trace element and isotopic signature, which is characteristic of shoshonitic series in collisional setting.

References: Campbell I. H., Stepanov A. S., Liang H., Allen C., Norman M., Zhang Q., Xie Y., The origin of shoshonites: new insights from the Tertiary high-potassium intrusions of Eastern Tibet, Contributions to Mineralogy and Petrology, accepted.