CONSTRAINTS ON THE EMPLACEMENT AGE OF YAKUTIAN PROVINCE KIMBERLITES FROM U-Pb PEROVSKITE DATING

L.M. Heaman[1] and R.H. Mitchell[2]

[1]Department of Geology, University of Alberta, Edmonton, Alberta, Canada, T6G 2E3
[2]Department of Geology, Lakehead University, Thunder Bay, Ontario, Canada. P7B 5E1.

Numerous radiometric ages for kimberlites from the Yakutian province in eastern Siberia have been reported (e.g. Brakhfogel' and Kovol'skiy, 1979; Davis et al., 1980) but many of these ages are older than that permitted by the geological relationships of the pipes. Despite the inherent limitations in some of these determinations, at least five periods of kimberlite emplacement have been proposed ranging from Late Ordovician to Late Jurassic (Davis et al., 1980; Sobolev, 1985). In order to better understand the tectonic significance of the Yakutian kimberlites, precise U-Pb perovskite dating is in progress on kimberlite samples from the Malo-Batuobinsk and Daldyn-Alakit fields in the south and from some of the diamond-poor kimberlite fields (Kuika, Lower Olenek) to the north. In many ways, perovskite is an ideal choice for determining the timing and origin of kimberlites because it is generally one of the few mineral constituents that contains appreciable amounts of U, Sr and Nd and can be shown to be a primary magmatic phase. The first phase of this project will focus on the temporal relationship between Yakutian kimberlite fields while phase two will involve a comparison of the nature of the subcontinental mantle source regions between diamond-rich and diamond-poor pipes from Sr-Nd isotopic studies of kimberlitic perovskite.

Preliminary U-Pb perovskite results for small (<0.5 kg) samples from two pipes located within the Kuika kimberlite field indicate that the diamond-poor kimberlites in this northern field are Jurassic in age. Perovskite from the Velikan II pipe are small, rounded, dark orange anhedral grains that are rimmed with a thin white coating (leucoxene?). The results for one analysis of 190 grains indicate moderate U (114 ppm) and Th (659 ppm) abundances and a $^{206}Pb/^{238}U$ age of 159.1±2.4 Ma (2σ). This 159.1 Ma age is considered a good estimate for the emplacement age of the Velikan II kimberlite. Abundant tiny tan perovskite fragments were recovered from a sample of the Monticellitovaya kimberlite and one analysis consisting of 469 grains yielded a slightly older $^{206}Pb/^{238}U$ age of 169.6±3.0 Ma(2σ) and slightly lower U (73 ppm) and Th (252 ppm) abundances. These Jurassic emplacement ages for kimberlites from the Kuika field overlap with U-Pb mantle zircon ages (159-146 Ma) reported for several kimberlites from fields further south (Davis et al., 1980) indicating that this period of Jurassic kimberlite magmatism occurs in a number of the Yakutian fields. It remains to be established whether all Yakutian Jurassic kimberlites, like Velikan and Monticellitovaya, are diamond-poor and hence poor exploration targets. Diamond-poor Jurassic kimberlite magmatism is not unique to the Yukutian fields as temporally equivalent, diamond-poor kimberlitic magmatism (159-152 Ma) is preserved in the Kirkland Lake field, North America (Heaman, 1989; Heaman and Kjarsgaard, 1995). The existence of temporally distinct diamond-rich and diamond-poor kimberlites in the same geographic location may

be controlled by additional factors other than the thickness and age of the subcontinental mantle root beneath stable Archean cratons.

References

Brakjfogel', F.F. and Koval'skiy, V.V. (1979) Age of the kimberlite bodies of the Siberian Platform. International Geological Review, 21, 307-313.

Davis, G.L., Sobolev, N.V., and Kharkiv, A.D. (1980) New data on the age of Yakutian kimberlites obtained by the uranium-lead method on zircons. Dokl. Akad. Nauk SSSR 254, 53-57.

Heaman, L.M. (1989) The nature of the subcontinental mantle from Sr-Nd-Pb isotopic studies on kimberlitic perovskite. Earth and Planetary Science Letters, 92, 323-334.

Heaman, L.M., and Kjarsgaard, B. (1995) Temporal evolution of North American kimberlites: link between magma corridors and subduction. In preparation.

Sobolev, N.V. (1985) Kimberlites of the Siberian Platform: Their geological and mineralogical features. *In*: Kimberlite, Occurrence and Origin: A Basis for Conceptual Models, eds. J.E. Glover and P.G. Harris, Geol. Dept. Univ. Western Australia Publication 8, 275-287.