V52A-06: Melt Inclusions in Olivine Provide Constraints on the Water Contents of Archaean Komatiites

Friday, 14 December 2018
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Komatiites are known to originate from extremely hot magnesium rich magmas that formed under the high degree of melting deep in the mantle and erupted on the Earth's surface mainly in the Archaean. Though the characteristic spinifex textures of komatiites that form due to significant thermal and chemical gradient in the magmatic flow, these rocks were first described only in 1969 in the Barberton Mountainland of South Africa [Viljoen & Viljoen, GSASP 1969]. Substantial quantity of studies have been done to understand the temperature regime and the mod of origin of the komatiites but little is known about the water contents of the komatiite magmas as most of Archaean komatiites are poorly preserved and do not provide the clear information on volatile components.

Here we report the substantial water contents yielding remarkably high H_2O/Ce ratios (1000-9000) in the melts trapped in olivine from the Archaean komatiites from the 2.7 Ga Abitibi Greenstone Belt, Canada [Sobolev et al, Nature 2016], 2.7 Ga Belingwe Greenstone Belt, Zimbabwe [Asafov et al, CG 2018] and 3.3. Ga Barberton Greenstone Belt, South Africa. Komatiites from these localities are among the best preserved and contain the pristine remnants of fresh olivine with partially crystallized and re-equilibrated melt inclusions. The experimental technique carried out in the Vernadsky Institute, Moscow and modeling allow reversing of the post-entrapment processes for further rigorous analytics. The data on water contents in the melt inclusions are confirmed by the indirect estimates of water by applying the Sc/Y olivine-melt geothermometer [Mallmann &O'Neill, JP 2013] and suggest the presence of moderate amounts of water (0.3-0.7 wt%) in the initial magmas. The high calculated temperatures of the initial komatiite liquids (>1500 °C) support their plume origin. The depletion in heavy hydrogen isotopes together with high Cl contents of the initial melts are consistent with the presence of the subducted material in the source of Archaean plumes, which implies the steady operation of subduction mechanisms before 3.3 Ga.

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