

Chlorine chemistry of altered oceanic crust

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Chlorine strongly partitions into aqueous fluids, thereby making Cl and its stable isotopes (^{37}Cl and ^{35}Cl) powerful tracers of fluid-rock interaction, including interaction between oceanic lithosphere and hydrothermal fluids. Although altered oceanic crust (AOC) is considered to be a major Cl reservoir estimated to subduct $\sim 2.5\text{-}3 \times 10^{12}$ g of Cl worldwide each year [1, 2], work on the Cl chemistry of AOC is surprisingly limited. Here I present new Cl concentration and isotopic data for AOC from seven DSDP/ODP/IODP drill sites (801C, 735B, 894F/G, 504B, 1256D, 417A/D/418A, 332A/B), greatly expanding the previous data set.

Chlorine concentration and $\delta^{37}\text{Cl}$ values of AOC are heterogeneous among and within individual drill sites. Cl concentrations range from <0.01 to 0.09 wt% ($n = 26$) and $\delta^{37}\text{Cl}$ values range from -0.8 to $+1.5\text{‰}$ (error $< \pm 0.2\text{‰}$) vs. SMOG (Standard Mean Ocean Chloride) ($n = 20$). These data greatly expand the range of previously reported AOC $\delta^{37}\text{Cl}$ values (-1.6 to -0.9‰ ; $n = 3$; Hole 504B; [3]). Neither Cl concentration nor isotopic composition is correlated with tectonic setting or crustal age. The Cl concentration decreases with depth in ODP Hole 735B from the SW Indian Ridge from 0.09 wt% at the top of the hole to <0.01 wt% at depth. A similar pattern is seen for $\delta^{37}\text{Cl}$ values ranging from -0.6 to $+1.5\text{‰}$ with the most positive values located near the top of the hole. The high Cl concentrations and $\delta^{37}\text{Cl}$ values are correlated with increased hydrothermal alteration (increased amphibole abundance) near the top of the hole. However, this trend is not consistent among all the holes implying that Cl chemistry is influenced by a variety of factors. Detailed future petrography and additional geochemical work will further test the correlation between Cl concentration and isotopic composition and mineralogy, as well as, examine the role of water-rock ratios, deformation, and temperature of hydrothermal alteration. These data can ultimately be used to reevaluate mass balance calculations improving our understanding of subduction recycling.

- [1] Ito *et al.* (1983) *GCA* **47**, 1613-1624. [2] Jarrard (2003) *Geochem., Geophy., Geosys.* **4**, doi:10.1029/2002GC000392. [3] Bonifacie *et al.* (2007) *Chem. Geol.* **242**, 187-201.

Is the platinum in the Bushveld complex derived from the lithospheric mantle ?

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The Bushveld Complex of South Africa contains $\sim 80\%$ of the world's Pt and almost half of its Pd resources in the form of three large ore deposits, the Merensky Reef, the UG-2 reef and the Platereef. Two questions arise a) were the magmas that formed the Bushveld Complex particularly Pt- and Pd-rich? and b) what is the origin of these magmas? In order to consider these questions we have estimated the composition of the Bushveld magmas based on 40 new whole rock analyses of quench textured rocks from the margins of the intrusion.

Broadly speaking, there are two types of magmas present, a Mg-rich basaltic andesite and a tholeiitic basalt. Both of these magmas are enriched in large ion lithophile elements, light rare earth elements and in Pb. Both magmas have negative Ta, Nb, P and Ti anomalies. The PGE contents of both magmas are similar to primary basalts and they do not appear to be enriched in PGE, except for Pt. The Pt/Pd ratio and Pt/Ti ratios are 1.5 to 2 times that of most basalts.

It is possible to model the lithophile element composition of the two magma types by up to $\sim 50\%$ crustal contamination of komatiitic basalt or picrite. This conclusion is supported by Sr, Nd and oxygen isotopic work. However, the Pt contents of the model magmas and the Pt/Pd and Pt/Ti ratios are much lower than those observed. An alternative is to suggest that the Bushveld magmas formed by partial melting of the metasomatised lithosphere. But, modeling using Kaapvaal mantle xenoliths compositions and MELTS shows that this magma would be too Al_2O_3 rich and SiO_2 poor.

Two possible solutions to this are: a) the melts formed by zone refining melting of the lithosphere (to attain usually high Pt concentrations) followed by contamination with crustal melts; OR b) the current estimate of primitive upper mantle with a Pt/Pd of 1 is incorrect and it should be closer to 2, in which case mixing of a plume derived magma with continental crust melts approximates the composition of the Bushveld magmas