Petrological characteristics of chromitite bearing gabbro from the Inazumiyama ultramafic complex of the Sangun zone, Southwest Japan

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Introduction

The podiform chromitites and associated peridotites in the Sangun zone in Japan have been interpreted as the product of harzburgite/melt reaction (olivine precipitation combined with dissolution of orthopyroxene of the wall) and related magma mixing (e.g. Arai and Yurimoto, 1994; Matsumoto and Arai, 1997, 2001) following the interpretation of Irvine (1975, 1977) for the stratiform chromitite. Almost all chromitite from the Sangun zone is always enclosed by dunite envelope. However we here show the petrology of the chromitite bearing gabbro from the Inazumiyama ultramafic complex of the Sangun zone.

Results and discussion

The Inazumiyama ultramafic complex is composed of harzburgite and small amount of dunite and chromitite, and is intruded by some gabbroic rocks. Hornblende gabbro is the most common. However Gabbroic rocks sometimes characteristically include chromitite clasts (a few to more than 10 centimeters in size). Chromitite bearing gabbro is chromian spinel bearing olivine pyroxene gabbro. Results of the mineral and bulk rock chemical composition indicate that the chromitite bearing gabbroic melt was produced as a result of the interaction of hornblende gabbroic melt and chromitite bearing peridotite.

References

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A new mechanism for intraplate magmagenesis and petrogenetic variation: The importance of process

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The view that tectonic plates are thin denies the possibility of generating intraplate magmas by splitting them. Tectospheres actually extend far deeper; in particular, the presence of interstitial melt (LVZ) deprives the mineral structure of water-weakening, making it strong, not mobile (Hirth & Kohlstedt 1996, EPSL). So a family of plate-splitting magmagenetic models is presented, treating MORs as the rapid-opening end of the range.

In the general model, the base of a plate may be put into extension by flexure or the penetration of cooling. This may then result in rapidly self-concentrating upward-necking of the plate. Sub-plate material thus drawn upward undergoes pressure-relief melting, endowing the column with net buoyancy to extend the narrow split to the surface. Melt segregation occurs by a log-jam mechanism, well-known to grouting engineers; the solids inevitably form a jam if they are bigger than ~25% of the crack width. In our case, the jam forms when wall cooling makes the solids grow again at shallower levels. Melt is forced through the jam, this depth determining its major-element composition. Continued opening of the crack is offset by wall accretion; continual re-forming of the jam permits the segregation of flood basalts. Rupturing of jams provides a source of xenoliths; the rupturing force depends on the melt column height above the jam, hence the increase in xenoliths from MORB to kimberlite.

Focussing first on OIB, the self-generated diapiric column in the crack produces a 'draw zone' at sub-lithostatic pressure around its base, so low-melting, trace-element rich and diffusible-gas mantle constituents are drawn from a wider zone than the material currently entering the crack, giving the magma a 'plume' signature (e.g. 3He and 87Sr) that is process-variable and not of lower mantle origin. Rapidity of transport and segregation within the crack inhibits thermodynamic equilibration between this signature and the major-element components. The mechanism offers a simple account of the alk-thol-alk-neph OIB sequence and of alkali basalts that precede or follow tholeiitic flood basalts.

Applied to MORs, wall accretion depends on lateral cooling; this gives a unique explanation of the straightness of MOR segments and, via columnar crystallization of olivine, of seismic anisotropy. Continuity of the MOR process means that the 'draw zone' signature effect becomes self-cancelling over time, but E-MORB is where this has failed.