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## Petrology of chromian spinel-bearing serpentinites in the Ise area, Hida Marginal Belt characteristics of their protolith

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The Ise area is located in the western part of the Hida Marginal Tectonic Belt (central Japan), which includes several sporadic exposures of ultramafic rocks sometimes forming serpentinite melange of Paleozoic age. Ultramafic rocks in the Ise area, enveloped by Paleozoic-Mesozoic sedimentary rocks, are completely serpentinitized; however, the abundance of bastite after orthopyroxene suggests harzburgite protoliths. The bastite- and mesh-textured serpentinites after orthopyroxene and olivine, respectively, are distinguished from each other in Al<sub>2</sub>O<sub>3</sub>, Cr<sub>2</sub>O<sub>3</sub> and NiO contents. The bastite-textured serpentine is high in Al<sub>2</sub>O<sub>3</sub> (up to 4.0 wt%) and Cr<sub>2</sub>O<sub>3</sub> (up to 1.2 wt%), but low in NiO (<0.3 wt%) relative to mesh-textured one. Relic chromian spinel is vermicular in shape and sometimes enclosed in orthopyroxene (bastites). It shows an intra-grain chemical homogeneity, and is sometimes altered to ferritchromite at the margin. It has an average composition of 32.0 wt% Al<sub>2</sub>O<sub>3</sub>, 14.0 wt% MgO, 36.0 wt% Cr<sub>2</sub>O<sub>3</sub>, 17.0 wt% FeO\* (total iron) and 0.03 wt% TiO<sub>2</sub>. The chromian spinel has a narrow range of Cr# [= Cr/(Cr + Al) atomic ratio] from 0.38 to 0.51 (0.43 on average) and low Fe<sup>3+</sup> [(Fe<sup>3+</sup>/(Cr + Al + Fe<sup>3+</sup>) atomic ratio, <0.03)], similar to chromian spinel in lherzolite-harzburgite from Kotaki and Oeyama ultramafic blocks. It is also similar in chemistry to spinels in forearc peridotite in supra subduction zone setting (SSZ). We found siegenite ((Ni, Co)<sub>3</sub>S<sub>4</sub>), millerite (NiS), violarite (Fe<sub>2</sub>+Ni<sub>2</sub>S<sub>4</sub>) and Cobalt gersdorffite Co-(NiAsS). The degree of melting using Cr# of chromian spinel is around 15-17% partial melting, which is slightly lower than the degree (around 18-25%) estimated by using Cr# versus TiO<sub>2</sub> model. This is consistent with the petrographical observation (harz. protoliths). The harzburgite protoliths were possibly serpentinitized by slab-derived fluids in SSZ during the exhumation process. The slab-derived fluids causing serpentinitization, which contained fluid-mobile elements (e.g., As), are responsible for formation of the Ni-Co-sulfides and arsenides.

Keywords: chromian spinel, sulfides, serpentinite, Ise, Hida Marginal Belt, Japan