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"Subduction Initiation" for the Genesis of Podiform Chromite Deposits

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There is a diversity of unusual minerals and mineral inclusions associated with podiform chromitites. The presence of these minerals suggests that grains of amphibolite (plagioclase, amphibole and zircon) and eclogite (coesite, kyanite and garnet) were present in the magmas from which chromite crystallized. Multiphase mineral inclusions demonstrate that podiform chromitites form from hydrous mafic magmas in suprasubduction zone environments. We propose a new model in which chromitite formation was involved in intra-oceanic subduction zones initiated in closing oceanic basins. Continued subduction carries oceanic and possibly continental crustal materials to deep levels where they are metamorphosed under greenschist, amphibolite and ecologite facies conditions. Tearing and breakoff of the subducted slab, possibly along the transitional contact

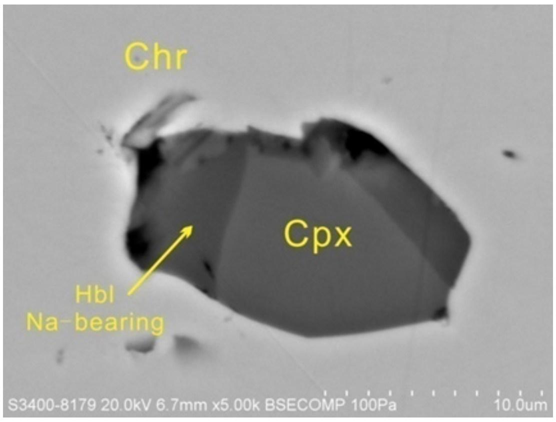

Fig. 1. Inclusions of clinopyroxene and amphibole in chromite are common.

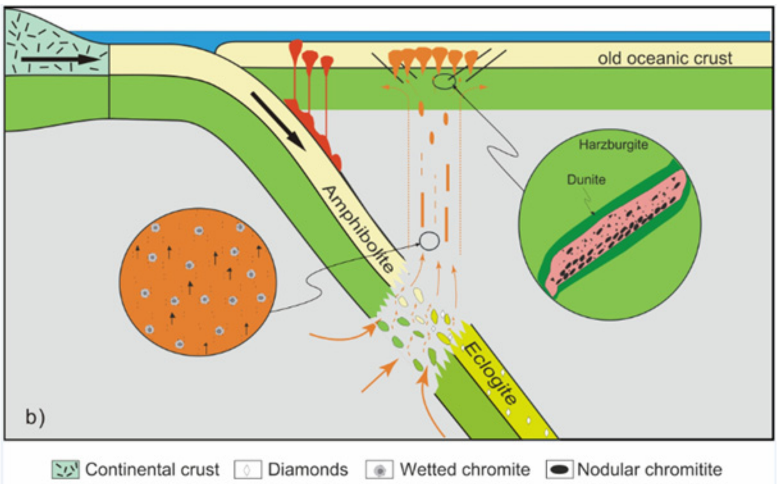

Fig. 2. A schematic diagram showing a possible model for the formation of podiform chromite deposits in ophiolites (not to scale). Note slab contamination of asthenopsheric melts in an intra-oceanic subduction zone of a closing oceanic basin.

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between amphibolites and eclogites, create a slab window through which the underlying asthenosphere rises and melts to generate Cr-rich mafic magmas. These upward-migrating magmas pass through the subduction zone and assimilate the subducted slab. As a result of slab contamination, these magmas become more siliceous, more oxidized and more hydrous, rapidly triggering chromite crystallization. Minute grains of chromite are suspended in the upward-moving magmas as they migrate through the overlying metasomatized mantle wedge. Such chromite-bearing magmas eventually deposit chromite in magma conduits in the uppermost mantle close to the Moho where the upward flow changes from vertical to subhorizontal and velocity is greatly reduced. Highly reduced and ultrahigh pressure minerals including diamonds are reported in literature both in podiform chromitites and host peridotites of ophiolites. Some of these minerals in association with host peridotites may have been brought by the uprising asthenosphere at mid-oceanic ridges due to the mantle convection. It is also possible that some diamonds may have formed in the subducted slab below about 150 km. Some minerals of subducted slabs are preserved because they are encapsulated in chromite grains where they are protected from the SSZ melts. Some of these SSZ mantle wedges are emplaced on land to become podiform chromitite-bearing ophiolites.

Reference

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