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"Black-colored olivines" in peridotites: dehydrogenation from hydrous olivines

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Fresh olivines that are black to the naked eye are found in some dunites. Peridotites are easily converted to be black in color, when serpentinized, due to production of secondary fine magnetite particles. The dunites that contain fresh but black-colored olivines are usually coarse-grained. These coarse olivine grains are sometimes very heterogeneous in color; the blackish part grades to whitish parts in single grains. The black color is due to homegeneous distribution of minute (< 10 microns) black particles in olivine. They are rod-like or plate-like in shape in thin section, sometimes being aligned under crystallographic control of the host olivine. Olivines are clear and free of these inclusions around primary chromian spinel inclusions or chromian spinel lamellae (Arai, 1978). Raman spectroscopy indicates the minute black particles are magnetite always associated with diopside. It is interesting to note that olivine in mantle peridotites accompanied by the black-colored dunites is totally free of the black inclusions, giving the ordinary colors (pale yellow to whitish) of Mg-rich olivine.
It is not likely that the magnetite inclusions formed through secondary oxidation of olivine by invasion of oxygen, which is possible along cracks or grain boundaries. They most probably formed due to dehydrogenation from primary OH-bearing olivines upon cooling. Hydrogen was quickly diffused out from the olivines to leave magnetite and excess silica. The excess silica was possibly combined with a monticellite component to form diopside. The OH-bearing (hydrous) olivines can be precipitated from hydrous magmas, and the hydrous nature of the magma can promote an increase in grain size due to faster diffusion of elements. The minute inclusions of magnetite + diopside is thus an indicator of primary hydrous character of host olivine.