Modification of mantle rocks by plastic deformation and origin of nodular chromitites in ophiolites

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Nodular chromitites from the Neo-Tethyan Luobusa ophiolite, Southern Tibet, are generally composed well-aligned chromite nodules and fresh dunitic matrices. Olivine grains in both the chromite nodules and dunitic matrices experienced pressure solution, and those grains in the dunitic matrices have Fe-rich stripes parallel to their kink bands and display lattice dislocation-induced preferred orientations of (100) sometimes. The Fo and δ^{56}Fe values of olivine grains in the dunitic matrices vary from 96 to 99 and 0.165 to 0.294, respectively. Chromite grains in the chromite nodules have Cr# ~ 75–80 and δ^{56}Fe values ranging from −0.122 to 0.067. Combined numerical modelling of Fe diffusion in olivine, our study indicates that the abnormally high Fo and δ^{56}Fe values of olivine grains in the dunitic matrices of nodular chromitites were not controlled by their parental magmas but caused by great loss of Fe from them under subsolidus conditions. Intensive plastic deformation in nodular chromitites largely promoted the migration of Fe from olivine into chromite nearby and largely facilitated the Mg-Fe exchange between the chromite nodules and dunitic matrices, maximizing the Fo and δ^{56}Fe values of olivine grains in the dunitic matrices. Boudinization of small chromitite bodies in less competent dunites under high temperature conditions (900-1200 ºC) is a potential mechanism for generating the nodular texture of chromitites. Effective mantle flow below spreading centers plays an important role in shaping the textures and compositions of mantle rocks [1].

[1] Goldschmidt, Zhang, P.F., Zhou, M.F., Liu, Q.Y., Malpas, J., Robinson, P.T. & He, Y.S. (2019) Modification of mantle rocks by plastic flow below spreading centers: Fe isotopic and fabric evidence from the Luobusa ophiolite, Tibet. Geochim. Cosmochim. Acta. doi.org/10.1016/j.gca.2019.03.008.