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Petrology and geochemistry of the ultramafic metamorphic rocks from the Masora domain, east-central Madagascar

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Madagascar is located within the interior of the Neoproterozoic East African Orogen (Jacobs and Thomas, 2004) that marks the join between East and West Gondwana. In the east Madagascar, the Paleo-Mesoarchean Antongil-Masora domains are exposed (Collins, 2006; Tucker et al., 2011). In this study we report the petrological and whole rock and REE geochemical characteristics of the ultramafic metamorphic rocks exposed within the Masora domain and we discuss their origin and tectonic settings. The Masora domain is mainly composed of the Paleo-Mesoarchean felsic metamorphic rocks with subordinate amounts of metasedimentary rocks (e.g. Randriamananjara, 2008; Tucker et al., 2011). This domain was intruded by Neoproterozoic granitoids and mafic-ultramafic rocks (e.g. Smith et al., 2008).

The ultramafic metamorphic rocks are exposed in the north and south Masora domain. Three types of ultramafic metamorphic rocks are identified in the north: peridotite, pyroxenite and hornblendite. The peridotite is mainly composed of olivine and anthophyllite with subordinate amounts of serpentine, magnesite and magnetite. The pyroxenite is mainly composed of clinopyroxene and hornblende with subordinate amount of magnesite and magnetite. The hornblendite is mainly composed of hornblende with subordinate amount of actinolite and magnetite. Some of the hornblendite has spinel. An ultramafic metamorphic rock body occurs as a lens within metasedimentary rock in the south. This metasedimentary rock is kyanite+biotite+muscovite schist. The mineral assemblage of the ultramafic lens differs between core and rim. It is mainly composed of olivine, tremolite, actinolite and chlorite with subordinate amounts of serpentine, magnetite and altered minerals in the core. The rim is mainly composed of tremolite, actinolite and chlorite with subordinate amount of magnetite and ilmenite.

The ultramafic metamorphic rocks except for the hornblendites have SiO_2 = 42.7-51.7 wt.%, Al_2O_3 = 1.5-7.5 wt.%, MgO = 19.8-35.4 wt.%, and CaO = 3.5-16.5 wt.%. They have high Mg# (molar ratio of $Mg^{2+}/(Mg^{2+} + Fe^{2+})$) of 0.76-0.83. On the basis of bulk rock CIPW normative Ol-Cpx-Opx composition, the ultramafic metamorphic rocks except for the hornblendites plot in the field of the lherzolite, olivine websterite and websterite (Streckeisen, 1976). Compared with the geochemical characteristics of abyssal peridotites (Niu, 2004), the ultramafic metamorphic rocks shows lower MgO, higher TiO_2 and CaO than those in the abyssal peridotites. On the MgO-Ni diagram (Pfeifer, 1990 in Katzir et al., 1999) one of the samples plot in the typical abyssal lherzolite field whereas the others plot in higher-Ni (orogenic) field. Chondrite normalized REE patterns of the ultramafic metamorphic rocks show flat HREE with variable LREE patterns. One of the samples shows enriched LREE pattern and the others show depleted LREE patterns. The depleted LREE samples have flat HREE with about twice amount of chondritic HREE abundances. This is typical characteristic of an orogenic lherzolite such as Ronda massif in the southern Spain and Lanzo lherzolites in the Italian Alps (Bodinier and Godard, 2003). Enriched LREE pattern is also a typical characteristic of pyroxenites occurring in orogenic peridotites (Bodinier and Godard, 2003). On the basis of petrological and geochemical characteristics, their protoliths are orogenic lherzolite, websterite and pyroxenite.

Keywords: Gondwana supercontinent, east-central Madagascar, geochemistry, Masora domain, ultramafic metamorphic rocks