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New Insights into the Tectonic Evolution of the UAE-Oman Ophiolite Suite

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The United Arab Emirates (UAE)-Oman ophiolite, a thrust sheet of Tethyan oceanic lithosphere that was emplaced onto the formerly passive continental margin of Arabia, is the largest and most well studied ophiolite with excellent preservation of the ocean plate stratigraphy of the obducted oceanic crust with related igneous and metamorphic rocks (Goodenough et al., 2014). Thus, the area provides a wonderful natural laboratory to study the subduction-obduction and their related processes in the mantle wedge at a convergent boundary (e.g., Searle and Cox, 2002; Rioux et al., 2013; Goodenough et al., 2014; Spencer et al., 2017; Joun et al., 2018). The UAE ophiolite belt preserves large slices of complete ocean plate stratigraphic section from mantle, lower crust, sheeted dikes, and pillow lavas of mid-ocean ridge basalt affinity, namely phase 1 magmatism, with intercalated pelagic sediments lying on top of the fault bounded metamorphic sole (Nicolas et al., 2000). This earlier oceanic crust is intruded by phase 2 magmatic rocks that consist of high-level gabbro, dolerite, basalt, pyroxenite, wehrlite and tonalite (Goodenough et al., 2014) with hydrous SSZ geochemical affinity (e.g., Rioux et al., 2013; Haase et al., 2016). Isotopic ages suggest that both magmatic activities are overlapped in the range of ca. 98.6 to 94.5 Ma (Rioux et al., 2016; Joun et al., 2018). These age spans are younger than about 5 Ma from the oldest age of the ophiolite. Apart from the magmatic history that formed the ophiolite crust, the obduction and exhumation history of the Semail ophiolite has been studied by various workers based on the nature of HP-metamorphism beneath the ophiolite complex (Searle and Cox, 2002; Styles et al., 2006). They reported a relatively wide range of ages from ca. 96 Ma (U-Pb ages, Rioux et al., 2016), ca. 92.4 – 94.9 Ma (Ar-Ar ages, Hacker and Gnos, 1997), ca. 89 – 101 Ma (K-Ar ages, Gnos and Peters, 1993). These ages are older than about 6 Ma compared with the youngest estimated ophiolite obduction age of ca. 93 to 83 Ma (Jacobs et al., 2015). These ages were suggestive of a subducting plate origin with crustal slices stacked below the overriding plate during the obduction (e.g. Searle et al., 2015).

However, we have reported the weighted mean age of ca. 91.8 Ma from the garnet metagabbro in Masafi metamorphic sole that is ca. 3 Ma younger to the protolith ages of ca. 94.5 and 94.9 Ma which are inferred from the oscillatory zoned zircons (Rioux et al., 2013), and is overlapped with previously reported metamorphic ages from the UAE ophiolite belt (Styles et al., 2006; Searle et al., 2015). The U/Pb ratios yield protolith ages of ca. 93.6 Ma for the olivine websterite sample and ca. 90.6 and 91.2 Ma for the tonalite samples. The same grains for the garnet metagabbro, phase 2 tonalite, and olivine websterite yield all positive ε_{HF} (t) values range from 5.6 – 10.0 for the ages 89 – 96 Ma, 5.1 – 10.0 for the age of 87 – 92 Ma, and 12.6 – 22.6 for the age of 89 – 96 Ma. These results indicate that the garnet metagabbro from this study originated from the mantle wedge, thus the overriding plate, formed through the metasomatism of depleted mantle with fluid derived from the subducting plate, rather than the subducted slab that has been interpreted as the origin of garnet amphibolite in general, although the positive ε_{Hf} value of the tonalite indicates the interaction during this mantle metasomatism as indicated by earlier research (Joun et al., 2018).

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