Petrogenesis of the Masirah ophiolite Mélange at Ras Madraka, Oman

Sobhi Nasir
Sultan Qaboos University, Earth Science Research Centre, Earth Sciences, Muscat, Oman (sobhinasir@hotmail.com)

The Masirah nappes are represented by allochthonous Late Jurassic to Cretaceous volcanic rocks and ophiolites well as Permian to Maastrichtian marine sediments, obducted onto the Oman continental margin at the cretaceous/Tertiary boundary (Schreurs and Immenhauser, 1999). The Masirah ophiolite forms a straight NNE-SSW trending strip 40 km wide, extending 450 km from Ras Madrakah to the Batain coast. The ophiolite is truncated by the ophiolitic mélange (known as Masirah Mélange) which makes a high angle with the sheeted dike trend and has been interpreted as a transform fault zone (Moseley and Abbotts 1979). The Masirah Mélange shows all the features characteristic of a tectonic mélange, in particular indefinite, non-stratigraphic, contacts and scanty matrix, indicating that it is not a diapiric mélange (Shackleton et al. 1990). The blocks within the mélange range in size from several kilometers to a few meters and are composed of blocks of all the rock types of the ophiolite beside metamorphic rocks. Metamorphic rocks from Ras Medraka Mélange are mainly composed amphibolite, two mica gneiss, and schist. The amphibolite consists of hornblende, plagioclase, clinopyroxene, sphene, chlorite, epidote, calcite, quartz, biotite, prehnite, magnetite, and ilmenite. Geochemical data shows amphibolites have similar MORBgeochemical characteristics. The Masirah ophiolite and mélange preserve a very long (80 Ma) history of igneous and sedimentary activity prior to emplacement onto the Arabian continental crust. However, dating of the mélange is so far proving difficult. It clearly post-dates the main ophiolite and pre-dates the early Tertiary (Shackleton et al. 1990).

This study is focused on providing age constraints for the amphibolite and greenschist facies metamorphic rocks of the Masirah Mélange in Ras Madraka by 40Ar/39Ar dating. All 40Ar/39Ar results were obtained in the ALF Argonlab, Freiberg University, Germany. Most of the samples show large degrees of Ar-loss or, in some cases, the presence of an excess Ar component, reflected by disturbed age spectra. In general, however, the large number of temperature steps measured in one hornblende sample allows the determination of well-constrained inverse isochron ages that generally provide a more robust error estimate than plateau ages. Laser stepwise heating of these hornblende samples yielded flat age spectra with plateau ages of 83.8±0.96 Ma.

The Indian Ocean was characterized by stepwise breakup of east and west Gondwana at 157 Ma, breakup of east Gondwana at 130 Ma, Madagascar and India/Seychelles at 95–84 Ma, India and Seychelles at 65 Ma, and, finally at 40 Ma, rifting between Africa and Arabia (Peters, 2000; Nasir...
The range from 160 Ma to 80 Ma suggests that magmatic activity in the Masirah ophiolite was more or less continuous over a period of ~80 Ma, and correlates with large-scale tectonic events recorded in the early Indian Ocean at 80-160 Ma. The 40Ar / 39Ar ages indicate that hornblende formed before 84 Ma and this age can be interpreted as cooling ages dating approximately the formation of the plastic deformation and abduction. We attribute the Masirah Mélange to the Madagascar and India/Seychelles breaking event at 95–84.