Geophysical Research Abstracts
Vol. 16, EGU2014-4668, 2014
EGU General Assembly 2014
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Age and geochemical constraints on the Makran arc magmatism, Iran

Kwan-Nang Pang (1), Sun-Lin Chung (1), Mohammad H. Zarrinkoub (2), Han-Yi Chiu (1,3), and Xian-Hua Li (4)

(1) Department of Geosciences, National Taiwan University, Taipei, Taiwan, (2) Department of Geology, Birjand University, Birjand, Iran, (3) Department of Physics and Earth Sciences, the University of Ryukyus, Okinawa, Japan, (4) Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China

Twenty one magmatic rocks were analyzed for major and trace elements, and a subset of them for Sr-Nd isotopes and zircon U-Pb isotopes, to constrain magma genesis and tectonic evolution of the Iranian segment of the Makran arc. Two samples from the Bazman volcano yield zircon U-Pb ages of 7.5 $\pm$ 0.1 Ma and 5.9 $\pm$ 0.2 Ma. Four samples from the Taftan volcano yield a cluster of ages at $\sim$3.4–3.2 Ma and one sample was dated at 0.84 $\pm$ 0.06 Ma. The obtained ages are consistent with the published K-Ar and 39Ar/40Ar ages for these volcanoes ranging from the Late Miocene to the Late Pleistocene. The Mirabad granitic pluton, which is close to and interpreted to be the root of the Taftan volcano, was dated at $\sim$19 Ma. The analyzed rocks show basaltic to rhyolitic compositions, calc-alkaline affinity and an orogenic geochemical signature revealed by enrichments in large ion lithophile elements, light rare earth elements and Pb, and depletions in high field strength elements and P relative to elements of similar incompatibilities. They have 87Sr/86Sr ranging from 0.7039 to 0.7084 and 143Nd/144Nd from 0.5123 to 0.5128, which are either depleted or enriched compared to the Bulk Earth. Major element thermobarometry of a relatively primitive basaltic sample indicate magma generation at $\sim$1400 $^{\circ}$C and $\sim$2.3 GPa on an anhydrous basis. Trace element ratios indicate that the sub-arc mantle wedge where the magma presumably formed had E-MORB-like compositions. Samples characterized by low 143Nd/144Nd tend to have relatively high Ba/La, Th/La and La/Yb, and low Ce/Pb, Nb/U and Ti/Ti*, consistent with assimilation of rocks from the upper continental crust. However, samples with the highest 143Nd/144Nd have lower Ce/Pb and Nb/U than magmas derived from the convecting asthenosphere, indicating that the orogenic signature was partly inherited from the magma source in addition to crustal contamination. This is consistent with the displacement above the mantle array in diagrams of Ba/Yb, Th/Yb and La/Yb against Nb/Yb, most likely caused by addition of Ba, Th and La to the source during Neotethyan subduction. Combined with available data, we suggest that the Makran represents a Neogene-Quaternary subduction factory and a window of continental collision between the Arabia-Eurasia collision zone to the west and the India-Eurasia collision zone to the east.