5.1.P14

The heterogeneous Hawaiian plume

K.T.M. JOHNSON[1], Z.-Y. REN[2], E. TAKAHASHI[2], T. SHIBATA[3] AND Q. CHANG[4]

[1] Dept. of Geology and Geophysics, University of Hawaii, 1680 East-West Rd., Honolulu, HI 96822, USA (kjohnso2@hawaii.edu)
[2] Earth and Planetary Sciences, Tokyo Institute of Technology, Tokyo 152-8551, Japan (ren@geo.titech.ac.jp; etakahas@geo.titech.ac.jp)
[3] Beppu Geothermal Research Laboratory, Kyoto University, Beppu 874-0903, Japan (tomo@bep.vgs.kyoto-u.ac.jp)
[4] JAMSTEC, Beppu Geothermal Research Laboratory, Beppu 874-0903, Japan (qchang@jamstec.go.jp)

Hana Ridge is the submarine portion of the east rift zone of Haleakala Volcano, Hawaii. At 140 km long, Hana Ridge is the longest submarine rift zone in the Hawaiian Island chain and has developed a complex morphology compared to other Hawaiian rift zones, such as Puna Ridge. The main ridge comprises two or three subparallel or subjacent ridges with distinct morphological expressions related to sequential accretionary stages of the shield-building phase of Haleakala volcano. In order to investigate the geochemical evolution of Haleakala shield-building, we sampled several sections of Hana Ridge on six dives with ROV Kaiko and Shinkai 6500 submersible, both operated by JAMSTEC, in 2001 and 2002.

We report geochemical data for 30 basalt samples from these six dives on Hana Ridge. All the recovered rocks are primitive tholeiites and picrites and more than half of them, those obtained in the deeper portions of the ridge, are picrites. Major and trace elements of the submarine Hana ridge rocks are similar to modern Kilauea and unlike Honomanu series lavas. Our results indicate that the mantle plume source for the Haleakala shield has changed over time from Kilauea-like, Kea-trend, compositions (high La/Sm, low Zr/Nb) in the submarine lavas to Mauna Loa-like, Loa-trend, compositions (lower La/Sm, higher Zr/Nb) in the subaerial Honomanu shield lavas. Moreover, the submarine stages show a gradual change from higher to lower La/Sm with location on the ridge. Likewise, Sr, Nd, and Pb isotope compositions change with location and appear to evolve from Kilauea-like to Mauna Loa-like compositions, although we have no age constraints as yet. We infer that the mantle source of Haleakala shield building lavas, like Koolau volcano on Oahu, changes over time as a function of passage over a zoned plume, which gets tapped sequentially to first produce melts similar to present-day Kilauea volcano and later to become more Mauna Loa-like during growth of Haleakala volcano.

5.1.P15

Nonlinear Sr-Nd trend of Kola alkaline province carbonatites (KAPC) as implication of the plum-related mantle metasomatism

V.M. SAVATENKOV[1] AND A.V. SERGEEV[2]

[1] Institute of Precambrian Geology and Geochronology, Russian Academy of Sciences (sava@VS5295.spb.edu)
[2] Department of Geology of Sant-Petersburg State University

The numerous Sr-Nd isotope data obtained during last decade for the carbonatites from the different Paleozoic alkaline-ultrabasic complexes on Kola Peninsula demonstrate contribution of isotopicaly heterogeneous sources. These data are offered to consider from point of view of single nonlinear trend in two-component system.

Three major models describing interaction of distinct sources as applied to Sr-Nd isotope variation of KAPC were considered: (1) mixing of mantle sourses, (2) assimilation-fraction crystallization and (3) metasomatic interaction.

The DM and EM I (EM II) were chosen as possible sources for the mixing model (1) and the DM and Archaean crust were chosen for the model (2). The results of model calculations demonstrate that neither mixing of the mantle sources nor assimilation by the crust material accompanied by fraction crystallization can give noncontradictory explanation of the observed nonlinear carbonatitic trend.

Metasomatic model describes the process of alteration of upper depleted sublitospheric mantle by ascending fluid (melt) bearing isotope characteristics of EM I (EM II). This model is based on an ion-exchange process in a mantle column between a solid and an infiltrating liquid. The shape of "metasomatic" curve on the 87Sr/86Sr-143Nd/144Nd diagram depends from the ratio of isotope equilibration rates between sublitospheric mantle rocks and lower mantle fluid for the Nd and Sr. An isotope equilibration rate in turn is directly proportional to diffusion rate and distribution coefficient. For the model calculation the typical Sr and Nd isotope compositions, their abundances for DM and EM and summary rock-melt distribution coefficients were used as reported in the literature. Accordingly to existing concept the Sr diffusion in the mantle rocks is faster than for Nd one. The KAPC data on the 87Sr/86Sr-143Nd/144Nd diagram are well approximated by resulting model curve.

Thus, the isotope composition of KAPC can reflect the different degree of plum-related metasomatic alteration of the sublitospheric mantle preceding to Paleozoic alkaline magmatism on the Baltic Shield. In the light of considered model the carbonatites of the Khibina complex reflect the maximum of metasomatic alteration of the sublitospheric mantle. Moreover this model is supported by data on the noble gas isotopy for the KAPC.