The Adakite-like Dacites and Potassic Volcanic Rocks in Chinese Western Tianshan

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The adakite-like dacites and potassic volcanic rocks (shoshonitic series and high K calc-alkaline rocks) are typical igneous rocks and closely associated in temporal and spatial in Chinese Western Tianshan.. They are mainly generated in late Paleozoic Era and the isotopic ages are 330-250 Ma using by ^{40}Ar-^{39}Ar and K-Ar methods. The adakite-like dacites and subvolcanic rocks (248.7 Ma ~ 260.8 Ma) are somewhat younger .

In the diagram of K_2O versus SiO_2, the adakite-like dacites and potassic volcanic rocks are plotted in the high K calc-alkaline and shoshonitic area, respectively. For the adakite-like dacites the Al_2O_3 contents are rather high (14.95-16.32) and Na_2O contents are mainly in the range of 5-7%. For the potassic volcanic rocks, the K_2O contents are high with range of 2.0-5.0%. These rocks are generally enriched in highly incompatible trace elements, such as LILE and LREE. The adakite-like rocks are strongly enriched in Sr with the highest concentration >1600 ppm, and strongly depleted in Y with the contents < 10ppm. The Sr/Y ratios are >50 (51-327) and fall right in adakite field and are apparently different from that of volcanic arc andasite and dacite. The REE distribution patterns are characterized by positive Eu anomalies (Eu*/Eu=1.15-1.27), strong HREE depletion and high $(La/Yb)_N$ ratios (17-34). These features show that the adakite-like dacites in Chinese Western Tianshan are similar to those defined by Defant and Drammond (1990,1993).

The variation of $(^{143}Nd/^{144}Nd)_i$ and $(^{87}Sr/^{86}Sr)_i$ of the adakite-like dacites are small: 0.51236-0.51248;and 0.7052-0.7054, respectively. The eNd(T) values are positive (1.98-4.23) and e Sr(T) values are low positive (15.7-17.3). For the potassic volcanic rocks the Nd and Sr isotopic compositions are very similar to those of adakite-like dacites, the $(^{143}Nd/^{144}Nd)_i$ and $(^{87}Sr/^{86}Sr)_i$ values fall in the range of 0.51232-0.51261 and 0.7041-0.7054, with eNd (T) and eSr (T) values of +1.28-+3.38 and ñ0.45-+18 respectively.. On the diagram of $(^{87}Sr/^{86}Sr)_i$ -e Nd(T) the adakite-like and potassic rocks are all fall into the first quadrant .This is similar to the island arc type of volcanic rocks in the Lesser Antilles and Sunda Arc.This suggests that the adakite-like and potassic volcanic rocks in Chinese Western Tianshan area may have been derived from similar source -mantle-derived with slight enrichment.

The trace element associations of these igneous rocks all show that they are mainly occurred in the continental arc and post collision arc tectonic settings and it could provide evidences for the regional Paleozoic geodynamic evolution.

A large scale of meteoric-hydrothermal alteration at Neoproterozoic in the Yangtze craton of China

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Since anomalous low $\delta^{18}O$ values of −10 to −8‰ were discovered for ultrahigh pressure (UHP) eclogite at Qinglongshan in the Sulu terrane, a cold paleoclimate was inferred to occur at Neoproterozoic. This provides an important constraint on the ongoing debate about the hypothesis of “snowball earth”. Because protoliths of granitic orthogneiss and most eclogites in the Dabie-Sulu orogen are of igneous origin, a extended study of the UHP rocks by means of zircon oxygen isotope analysis and U-Pb dating is carried out to identify the timing and areal distribution of the meteoric-hydrothermal alteration.

CO_2 laser fluorination analysis on 112 zircon samples from the UHP rocks shows $\delta^{18}O$ values of −10.3 to +5.6‰ in the Sulu terrane and −4.6 to +8.9‰ in the Dabie terrane. The analysed samples cover most regions of the Dabie-Sulu orogen, with an outcrop area of over 15,000 km^2. Almost a half of the zircon samples have the lower $\delta^{18}O$ values than the normal mantle zircon 5.3±0.3‰, indicating the involvement of surface fluids in the formation of the UHP rocks. In particular, the low-$\delta^{18}O$ magmas are expected for the protoliths of the UHP rocks.

Over 50 zircon U-Pb datings from either upper intercept of Wetherill-type discordia or ionprobe single $^{206}Pb/^{238}U$ point shows an age range of 600 to 880 Ma with a mode of 730 to 790 Ma for protoliths of most eclogites and orthogneisses in the Dabie-Sulu orogen. These ages may correspond to rift-magmatic events in the northern margin of the Yangtze craton. They are also correlated with the sedimentation timing of the Nantuo tillites on the Yangtze platform. The ^{18}O-depleted fluid may be associated with the Neoproterozoic glaciations in a fashion of either cold paleoclimate or melting of snow or glacier ice.

Because meteoric water is the only source of ^{18}O-depleted fluids on the Earth, it is commonly assumed that low $\delta^{18}O$ values for igneous and metamorphic rocks are produced by meteoric-hydrothermal alteration at high temperatures. Alteratively, melting of glacier ice is proposed to produce the ^{18}O-depleted fluids, and the Neoproterozoic rift-magmatism in the northern margin of the Yangtze craton is considered as the heat source that melts the glacier ice to trigger the water–rock interaction. Therefore, the widespread occurrence of the negative $\delta^{18}O$ values for the zircons of the Neoproterozoic ages are a manifestation of the snowball Earth at that time.