Geochemistry and zircon SHRIMP dating on the Late Paleozoic volcanic rocks in west Tianshan Mountains (Central Asia, Xinjiang)

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The Late Paleozoic volcanic rocks in western Tianshan Mountains (Central Asia) formed the strata up to 10000m in an area of large than 30000km^2. These volcanic rocks distribute in TAS plot continuously from basalt, basaltic trachyandesite, trachyandesite, trachyte, to rhyolite. The zircon SHRIMP dating shows that the zircons from basalts and trachy-andesites vary between 299 Ma and 395 Ma with following sequence: zircons from altered basalts in the eastern part of the studied region give an average age of 324.8±4.9 Ma (MSWD = 3.01, n=13); zircons from another samples (also basalt) taken from the same region give an average age of 316.0±3.3 Ma (MSWD = 1.26, n=9); zircons from trachy-andesite covered on the altered basalts give an average age of 312.8±4.2 Ma (MSWD = 1.7, n=8, which represents the crystallizing age of zircon rims in trachy-andesite). However, basalts cropped out in the region about 100 km western of the above basalt-trachy-andesites have a SHRIMP age of 353.7 ±4.5 Ma (MSWD = 1.7, n=13). Zircons separated from the basaltic andesites cropped out in the western part of the studied region give an older SHRIMP age of 363.1 ±1.3 Ma (MSWD = 1.3, n=13). All analyses fall on the U-Pb concordant line. The acquired five ages belong to the Late Devonian, Early Carboniferous, and Late Carboniferous epochs, respectively.

The genesis of these volcanic rocks remains to be controversial. It has been proposed to be relevant to “rift” or “plume”. Detailed petrology and geochemical data presented here show that these volcanic rocks represent continental arc magmatism. The magma source is enriched in LILE, Th and Pb, and depleted in HFSE and Ce. Trace element geochemical study suggests that the basalts could be modeled by 7-11% partial melt of garnet lherzolite. The isotopic compositions are variable for the studied volcanic rocks in west Tianshan Mountains. The Late Carboniferous trachyandesite - trachyte - rhyolite characterize with relative high $\varepsilon_{Nd(T)}$ values (+2.68~+4.29) and high initial $^{87}Sr/^{86}Sr$ ratios (0.7015~0.7051). The trachyandesite - rhyolite have relatively low $\varepsilon_{Nd(T)}$ values (-0.22~+0.87) and variable initial $^{87}Sr/^{86}Sr$ values (0.7045~0.7068). The Early Carboniferous basalts have low and less variable initial $^{87}Sr/^{86}Sr$ ratios (0.7045~0.7058), but their $\varepsilon_{Nd(T)}$ values are high and highly variable (+0.89~+3.04). Basalt is originated from the partial melting of the enriched mantle wedge. The geochemical characteristics of the Late Carboniferous trachyandesites covering on basalts suggest that continental materials involved in the formation of their magma. The volcanic rocks in the west Tianshan Mountains represent the continental arc of the Paleo-Southern Tianshan Ocean, and the tectonic environment gradually shifted from typical continental arc (western part, Late Devonian to Early Carboniferous) to post-collisional setting (eastern part, Late Carboniferous).

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