Early Paleozoic high-Mg andesites in NE China: a tectonic resemblance to SW Japan?

*Wenzhu Hou[1]

1. The University of Hong Kong

A suite of high-Mg volcanic rocks (MgO=7.05-10.73%, Mg#=65-73) with silica compositions ranging from 50% to 68% was discovered in Duobaoshan area, NE China. No parental relationships existed between the basalts and andesites as andesites displayed the highest Mg# (68-73) of all and may represent the near-primary magma. The magma differentiation cannot be explained by the simple fractional crystallization process as normally thought. Detailed geochronological and geochemical studies were conducted for this suite of volcanic rocks to discuss their ages, petrogenesis and tectonic settings, which may shed new light on the geological evolution of the whole region.

NE China is the major component of the eastern segment of the Central Asian Orogenic Belt (CAOB) and recorded the long-lasting accretionary orogeny during the Paleozoic amalgamation of the Central Asia. Numerous island arcs, subduction complexes, continental margins, sea mounts and ophiolites have been discovered and reported along this belt, particularly in its western and central segment, which marks its complex and protracted accretionary history. However, in the studied area, the tectonic model remains debatable. The sampling location is at the southern border of the Xing'an block, one of the several micro-blocks composing the easternmost CAOB (others include the Erguna and Songliao blocks), and the samples are generally considered to relate with the subduction and accretion processes of the Paleo-Asian Ocean (PAO, the paleo-ocean once existed between the North China Craton and Siberia).

Two samples were selected to conduct the accurate LA-ICP-MS U-Pb zircon dating and 30 analyses were carried out for each of them. The CL imaging and measured Th/U ratios indicated the heterogeneity of the zircon sources, with both co-magmatic zircons and inherited ones. The co-magmatic zircons with euhedral morphology and relatively clear concentric zonings clustered tightly to define the approximate eruption age, which is in upper Ordovician (460 Ma and 444 Ma). The xenocrystic zircons were basically subhedral to rounded in shape without clear zonings or with metamorphic core-rim structure, and they yielded a complex profile including ages similar to 550 Ma, 0.8 Ga, 1.2 Ga, 1.8-1.9 Ga, and 2.3-2.5 Ga, which may deliver critical information from the continental crust of the Xing'an block.

All samples were plotted as calc-alkaline series in the Co-Th diagram, which was used to avoid the influence from secondary process given the relatively high L.O.I. Apart from the high Mg abundance, samples also displayed high Al compositions (Al_2O_3=15-20%). The total REE abundance was low (ΣREE=120-164ppm) and typical arc-affinity geochemical features were shown, including the slightly enriched LREE ($(La/Yb)_N$=6.8-9.3) and a lack of Eu anomaly (Eu/Eu*=0.9-1.0). The LILE and highly incompatible elements were also enriched such as Cs, Ba, Th, U, Pb and Sr, compared with the HFS (Sr/Y=18-37). The twin elements of Nb-Ta and Zr-Hf were not severely depleted, indicating the enrichment from the metasomatized upper mantle. Other characters include the highly fractionated Cs and Rb (Rb/Cs<20), subtly decoupled Th and U (Th/U=3.3-3.6), supra-chondritic ratio of Zr/Sm (31-41), which all have been experimentally proved related with the partial melting of the subducted oceanic slab with recycled sediments. This featured subduction-derived high-Mg volcanic rocks, particularly high-Mg andesites (HMAs), were also discovered in the Setouchi Volcanic Belt, SW Japan (Tatsumi, 2006). With the synthesized age and geochemical data, we suggest that the arc magmatism by the subduction of the PAO

was happening during the upper Ordovician along the southern border of the Xing'an block, and the tectonic environment probably resembled the SW Japan.

Reference:
Tatsumi, Y. (2006). High-Mg andesites in the Setouchi volcanic belt, southwestern Japan: analogy to Archean magmatism and continental crust formation?. *Annu. Rev. Earth. Planet. Sci.*, *34*, 467-499.

Keywords: Central Asian Orogenic Belt, High-Mg Andesites, Continental Arc

