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Oceanic Island Basalts from the Darbut and Karamay Ophiolitic Mélange in West Junggar (NW China): Product of a Middle Devonian Mantle Plume?

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The Central Asian Orogenic Belt (CAOB) is an immense accretionary orogen and is an important site of Phanerozoic crustal growth (Fig. 1a; Sengör et al., 1993; Jahn, 2004; Windley et al., 2007; Xiao et al., 2008; Safonova and Santosh, 2014). The West Junggar, situated in the southern CAOB (Fig. 1b), including several belts of ophiolitic mélanges (Feng et al., 1989; Zhou et al., 2001; Wang et al., 2003), such as Mayle, Tangbale, Darbut, Karamay, Huguleleng and Kujibai. Oceanic island basalts (OIB) occur in many ophiolitic mélange belts and accretionary complexes, but those geological structures are usually dominated by "classic" ophiolitic units, island/ back-arc units and their metamorphosed equivalents. Outcrops of oceanic island basalts, seamounts and plateaus are, as a rule, much smaller in size and easily either missed or erroneously interpreted. The exceptions are the large oceanic plateaus, which can be both subducted or accreted, and consequently they are also of limited extent (e.g., Kerr, 2003).

In this paper, we focus on recently discovered oceanic island basalts from the Darbut and Karamay ophiolitic mélange in West Junggar (NW China). Both mélanges consist of harzburgite, pyroxenite, dunite, cumulate, pillow lava and podiform chromite. The stable marine volcanic-sedimentary sequences mainly compose of red chert, sandstone, basalt and little siliceous limestone. Zircon U-Pb ages reveal that basalt from the Darbut and Karamay ophiolitic mélange were emplaced at 375±2 Ma, 395±3 Ma, respectively. All basalts bear the signature of OIB, and are characterized by alkaline compositions with high concentrations of Na_2O + K_2O (3.7–8.5wt%) and TiO_2 (1.5–3.1wt%); LILE and LREE enrichment and HREE depletion; very weak or no Eu anomalies (Eu/Eu* = 0.9–1.0); and no obvious Nb, Ta or Ti negative anomalies. The samples exhibit relatively low initial 87Sr/86Sr ratios (0.69928–0.70510), and positive εNd(t) (3.68–8.27) values with a young model age. Moreover, the enriched mantle source could have contained 2%–5% garnet and ~3% spinel. The rocks also display strong geochemical similarities with the Bibai (Mahoney et al., 2002), Oahu (Clague et al., 2006), Xigaze (Xia et al., 2008) and Dongbo (Liu et al., 2013) basalts and typical OIB (Sun and McDonough, 1989).

Therefore, we suggest that the alkaline basalts from the Darbut and Karamay ophiolitic mélange in West Junggar weregenetically linked to a Late Devonian mantle plume (Yang et al., 2013; Fig. 1c). If the plume model as proposed here is correct, it would suggest that mantle plume activity made major contributions to crustal growth in the CAOB.

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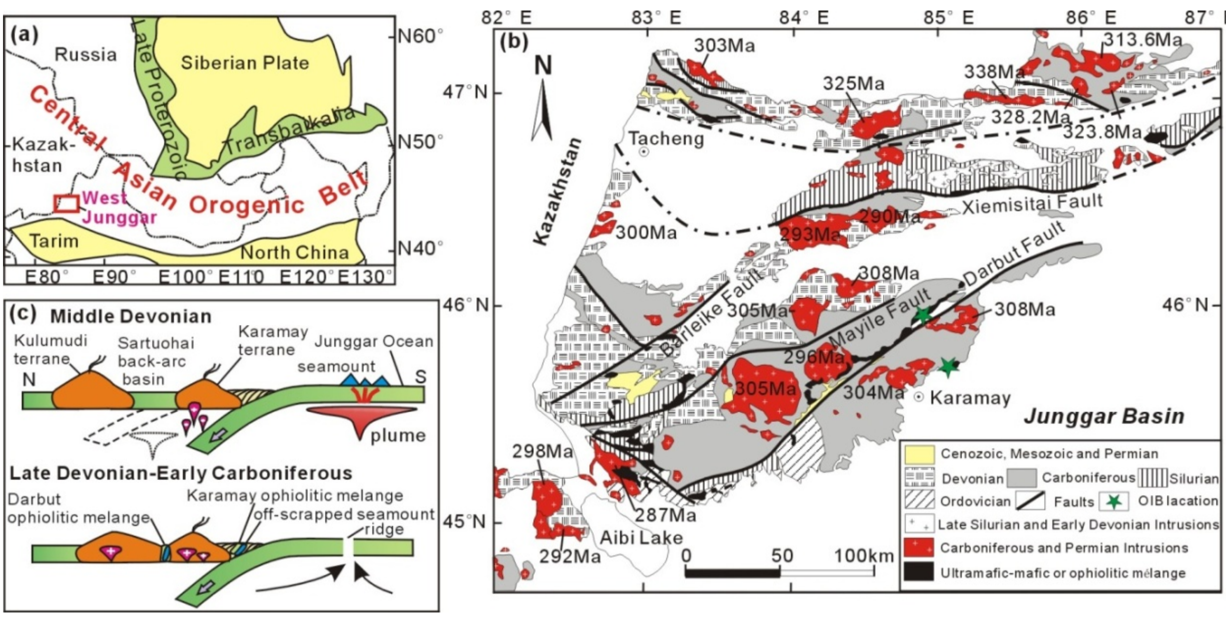

Fig. 1. (a) Simplified tectonic sketch of the CAOB ; (b) Geological map of the West Junggar; and (c) A sketch illustrating the formation of the alkaline basalts in CAOB genetically related to a mantle plume.

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