**Supplementary Material**

**Fig. S1.** Lithostratigraphic columns for three segments of the central UDMA (i.e. Kahak, Ardestan, and Nodoushan) selected for the present study on mafic-intermediate volcanic rocks. Simplified geological maps are given in Fig. 1.

**Fig. S2:** Photomicrographs of the major mafic volcanic rock types from the Central UDMA in thin section, in plane-polarized light. Abbreviations: Ol, olivine; Opx, orthopyroxene; Cpx, clinopyroxene; Pl, plagioclase (after Whitney and Evans, 2010).

**Fig. S3.** Major elements versus SiO2 variation diagrams for the mafic-intermediate volcanic rocks of LILE-poor (a), LILE-rich (b), and ITE-rich (c) series from different segments of the study areas (i.e., Kahak, Ardestan and Nodoushan areas) in the central UDMA. LILE and ITE are the abbreviations for Large Ion Lithophile Elements and Incompatible Trace Elements respectively.

**Fig. S4.** Primitive mantle normalized trace element patterns for the mafic-intermediate volcanic rocks from the Tafresh area (i.e. 100 km towards the NE of Kahak in the northernmost part of the study area) from the central UDMA. Trace element data are adapted from Ghorbani and Bezenjani (2011) and age dated samples are from Ghorbani et al. (2014). See text for details. Normalizing values are from Sun and McDonough (1989).

**Fig. S5.** Primitive mantle normalized trace element patterns for the mafic-intermediate volcanic rocks from the Ardestan area of the central UDMA. Trace element data and age dates are from Yeganehfar et al. (2013). See text for details. Normalizing values are from Sun and McDonough (1989).

**Fig. S6.** (a-c) Initial Sr-Nd-Pb isotopic ratios plot for the mafic-intermediate volcanic rocks from the W Nain (Yeganehfar et al., 2013) and Nodoushan (Jolani Varzeghani, 2017) areas of the central UDMA. See caption Fig.5 for details. Sixteen samples are from W Nain (HK40, HK41, HK42, HK44 from LILE-rich series; HK46, HN51, HN54, HT75, LZ80, HT71, HT72, HT73, HT74 from LILE-poor series and HN53, HN55, HK43 from ITE-rich series) along with from Nodoushan (AN19, AN27 from less differentiated samples, blue circles; and AN14, AN33, AN34 from more differentiated samples, green circles).

**Table S1.** Petrographic features of the mafic volcanic rocks of the LILE-rich, LILE-poor, and ITE-rich series.

**Table S2.** Major oxides (wt%) and trace elements (ppm) abundances of the mafic-intermediate volcanic rocks from the Kahak (including Fordou and Vadghan), Ardestan (including Mishab, Marbin, and Kahang), and Nodoushan areas in the central UDMA. Sample locations are given in Fig. 1. Data for three samples, UC 27, UE 41, and UE 46 are from Ghorbani et al. (2014). Trace elements analysis of the samples numbered in normal fonts were analyzed in the Genalysis lab, Perth, Australia and for samples numbered in italic fonts were analyzed at the School of Geography, Earth and Atmospheric Sciences, University of Melbourne, Victoria, Australia (see “Methods” for details). Note: LOI = Loss On Ignition. Mg# = Mg/[Mg+Fe2+] mol%, assuming Fe2O3 = 0.15 FeO (Kress and Carmichael, 1991). 50% of the volcanic rocks from the LILE-rich series show Mg# > 48; for 82% of the volcanic rocks from the LILE-poor series and 70% of the ITE-rich series rocks the Mg# are > 49 and > 46 respectively.

**Table S3.** Sr-Nd-Pb isotopic ratios of the representative mafic rocks from the Kahak and Ardestan areas in the central UDMA. The initial isotope ratios were recalculated by assuming an age of 35 Ma. As the replacement for a sample from the Kahang with ‘primitive LILE-poor signatures’ (i.e., the one with strong negative Zr anomaly), the UA.2 sample with similar whole rock geochemistry from Tafresh (see Fig. 1) is selected.

**Table S4.** In-house standards measured at Genalysis Laboratory and the University of Melbourne. All numbers are in ppm.

**Table S5.** Isotopic ratios and trace element contents as well as explanation of the procedure used to calculate the proportions of the different end-members in the isotopic mixing modeling. The superscripts to the right to the end-members denote the references.

**References** (only referred to in the supplem.)

Kress, V. C., and Carmichael, I. S. E.: The compressibility of silicate liquids containing Fe2O3 and the effect of composition, temperature, oxygen fugacity and pressure on their redox states, Contrib. Mineral. Petrol., 108, 82–92, https://doi.org/10.1007/BF00307328, 1991.

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