The Durkan Complex in the western Makran Accretionary Prism (SE Iran): Evidence for a Late Cretaceous tectonically disrupted oceanic seamount

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INTRODUCTION AND GEOLOGICAL SETTING

The Makran Accretionary Prism is an E-W trending accretionary prism in the SE of Iran that is bounded by two strike-slip fault systems (**Fig.1**). The Makran has resulted from the Cretaceous to present-day convergence between the Arabian and Eurasian plates that was accomodated by the northward subduction of the Neo-Tethys Ocean beneath the southern margin of Eurasia (McCall & Kidd, 1982; Burg, 2018). This subduction is still active beneath the Makran in the Oman Gulf (**Fig.1**).

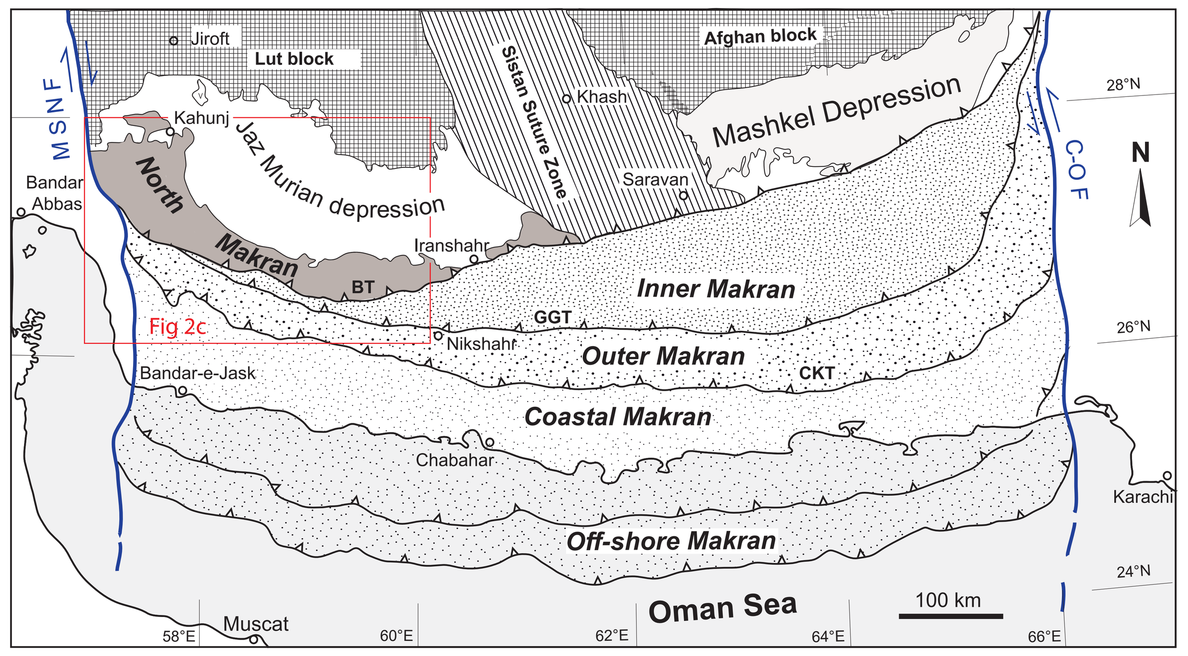

Figure 1 *Tectonic scheme of the Makran (modified after Burg, 2018)*

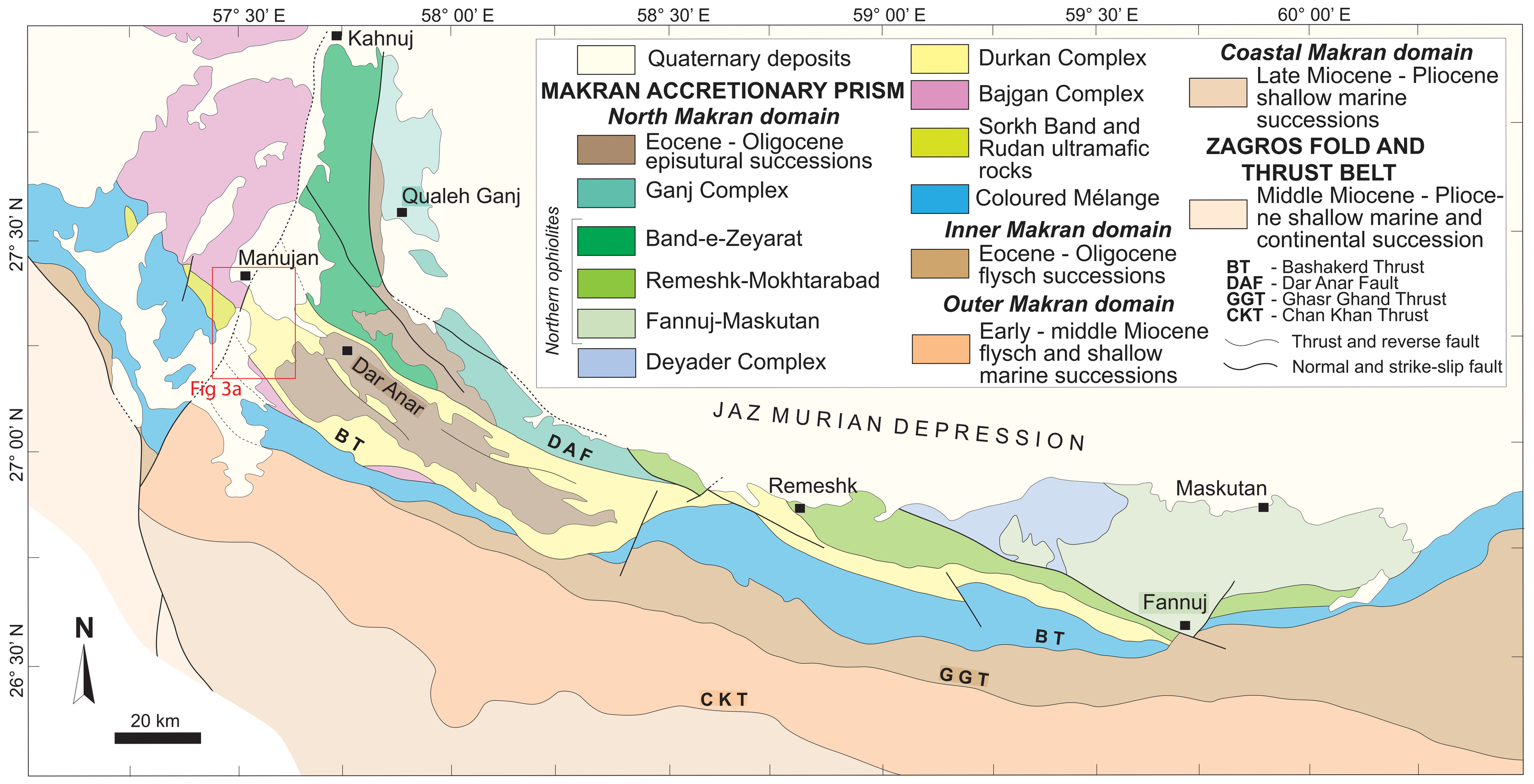

Figure 2 *Tectonic scheme of the western Makran (from Barbero et al., 2020)*

The Makran Accretionary Prism has been subdivided in four fault-bounded tectono-stratigraphic domains, that are, from North to South: i) North Makran ii) Inner Makran iii) Outer Makran and iv) Coastal Makran (**Figs.1, 2**). The Inner, Outer and Coastal Makran are characterized mainly by Eocene to Pliocene deep to shallow water sedimentary succession (Burg, 2018), whereas the North Makran consists of an imbricated stack of south-verging metamorphic and non-metamorphic continental and oceanic units (e.g., McCall & Kidd, 1982; Burg, 2018). The North Makran domain record the pre-Eocene geodynamic history of the Makran Accretionary Prism (McCall & Kidd, 1982;Burg, 2018; Saccani et al., 2018; Barbero et al., 2020).

The Durkan Complex is one of the major tectonic elements of the North Makran and consists of several tectonic slices, which include deformed Early Cretaceous-Paleocene carbonatic and volcanic successions, as well as rare Carboniferous, Permian and Jurassic slices of platform limestones (Hunziker et al., 2015). The Durkan Complex is commonly interpreted as representing the disrupted sedimentary cover of the passive margin of a micro-continent known in literature as the Bajgan-Durkan Complex. However, its stratigraphic succession, as well as the age and geochemistry of the volcanic rocks are still poorly known. Nevertheless, such data are fundamental for constraining its meaning for the pre-Eocene geodynamic evolution of the Makran Accretionary Prism.

We present new geological, stratigraphic, biostratigraphic data on the sedimentary and meta-sedimentary successions as well as new geochemical data on the associated volcanic and meta-volcanic rocks cropping out in the western sector of the Durkan Complex (i.e., in the Manujan area, **Figs. 2, 3**). These data are fundamental to define the tectono-stratigraphic architecture of the western Durkan Complex and they can provide robust constraint for understanding the significance of the Durkan Complex for the geodynamic evolution of the Makran Accretionary Prism

NEW FIELD DATA

We had investigated in detail the tectono-stratigraphic architecture of the western Durkan Complex by studying four key transects in which different stratigraphic successions are well preserved within distinct tectonic slices (**Fig. 4**). These slices are characterized by showing both slightly metamorphic and non-metamorphic highly-deformed stratigraphic successions.

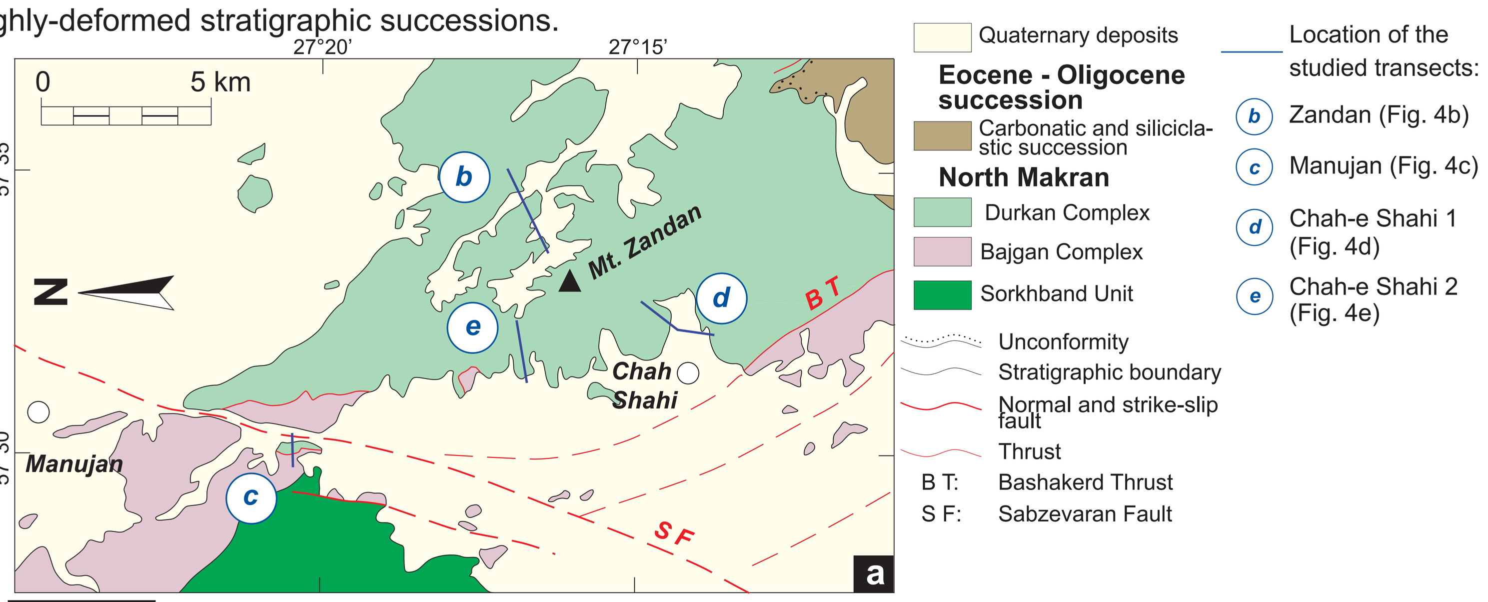

Figure 3 *Geological scheme of the studied area (modified from Samimi Namim, 1983)*

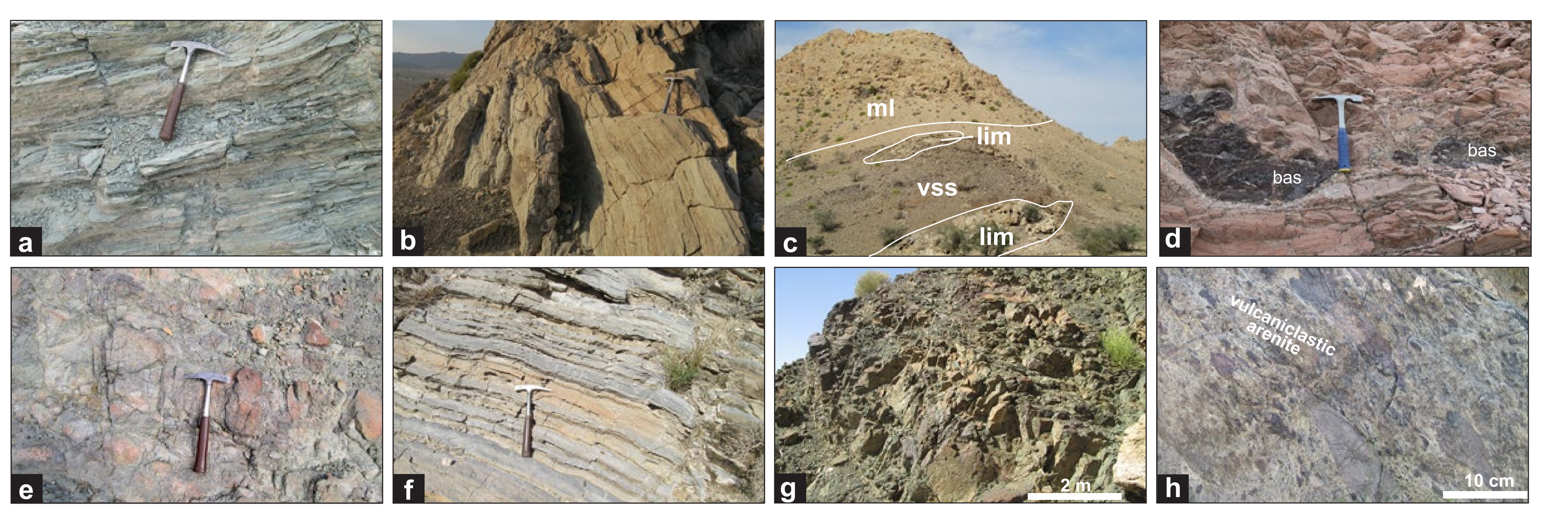

Figure 5 *Field occurences of the Durkan Complex in the studied transects:*

a) foliated meta-volcaniclastic arenites; b) massive marble; c) panoramic view of the contact between the Volcano-Sedimentary Sequence (VSS) and the Massive Limestone (ml) lithostratigraphic units; d) primary stratigraphic relationships between lavas and pelagic sedimentary rocks; e) volcanic rocks in the Volcanic Sequence; f) thin bedded limestones alternating with shaly-marls (Limestone and Shale); g) massive volcanic rocks alternated with volcaniclastic arenites from the Volcanic Sequence; h) matrix-supported breccia from the Volcano-Sedimentary Sequence showing limestone and shale clasts in a fine-grained greyish to greenish matrix;

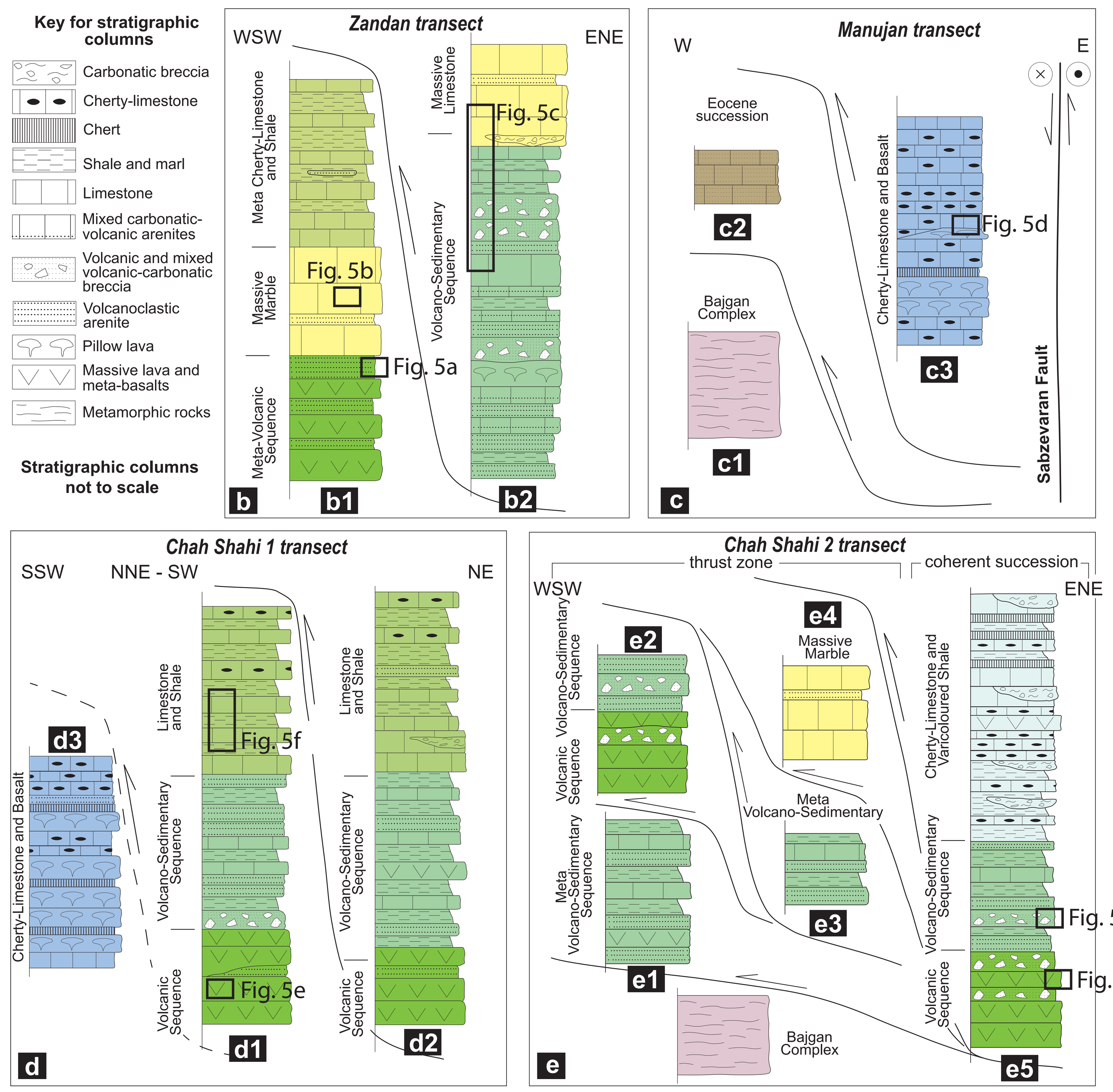

Figure 4 *Schematic stratigraphic-structural setting and stratigraphic columns for the successions in the studied transects*

BIOSTRATIGRAPHY

Biostratigraphic analysis were aimed to date the sedimentary rocks associated with the volcanic rocks, in order to provide age constraints for the magmatic activity. The biostratigraphy is based on the integration of foraminifera, radiolarians and calcareous nannofossils. The results are shown in **Figure 9**.

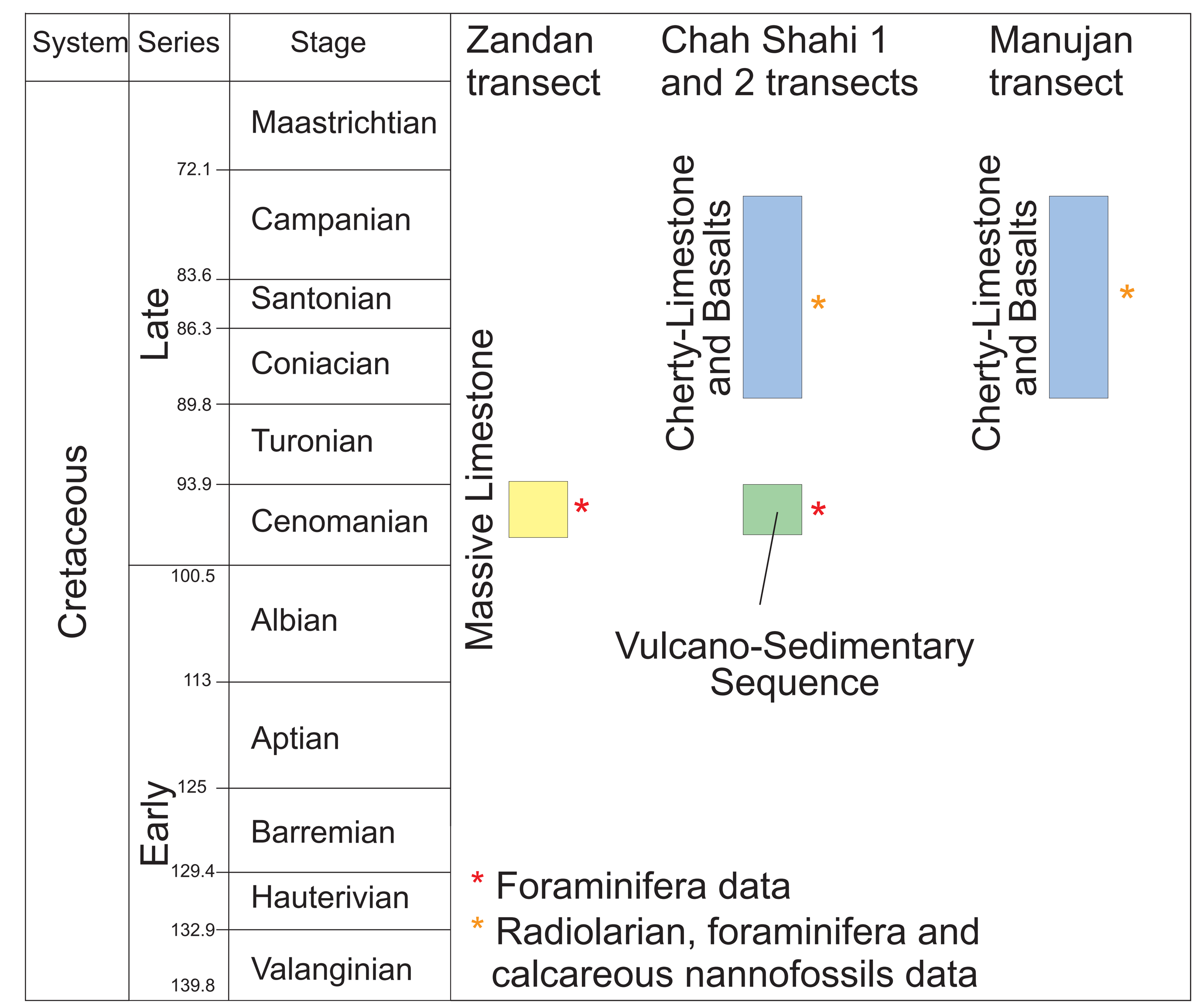

Figure 9 *Summary of the results of the biostratigraphic analyses*

CONCLUSION

In summary, our data indicate that the western Durkan Complex successions have recorded complex Late Cretaceous interplay of sedimentation and alkaline magmatism, which is significantly younger than the Middle Jurassic - Early Cretaceous rifting stages recognized in literature in the eastern Durkan Complex.

The distinct successions of the Durkan Complex show tectono-stratigraphic features that can be reconciled to the cap (**Figs. 4b, 4e4**), the slope (**Figs. 4d1, 4d2, 5e2, 5e5**), and the foothill (**Figs. 4c3, 4d3**) of a typical seamount environment. Finally, our new findings and regional-scale comparisons suggest that the Late Cretaceous alkaline magmatic pulse recorded in the Durkan Complex was likely related to mantle plume activity in the Makran sector of the Neotethys.

GEOCHEMISTRY

Volcanic rocks in all the transects show very similar geochemical features. They mainly consist of alkaline basalts and minor trachybasalts showing high Nb/Y ratios (0.62 – 4.4). According to the REE abundance (Sun & McDonough, 1989) we distinguished three groups of rocks showing marked but different enrichment of LREE and MREE with respect to HREE (**Fig. 6**). In the Th_N vs Nb_N discrimination diagram (**Fig. 7**) they plot in the field for P-MORB and Alkaline basalt from subduction unrelated setting. These rocks have Zr and Th/Ta ratios similar to those of Oceanic Island Basalt rather than those of continental margin settings (**Fig. 8**). These geochemical features indicate an enriched mantle source for the volcanic rocks of the Durkan Complex (e.g., Safonova et al., 2016).

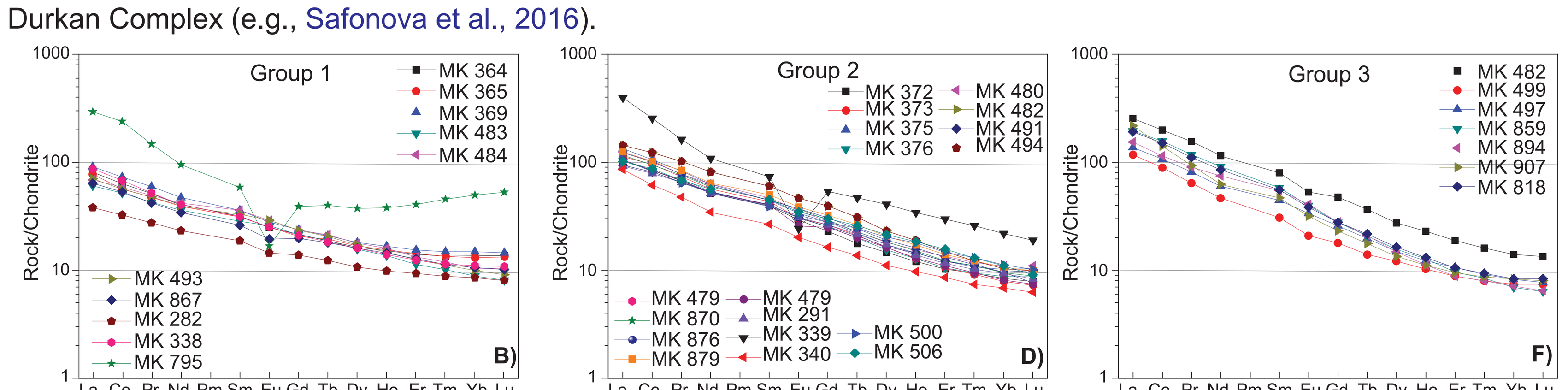

Figure 6 *Chondrite-normalized REE patterns for magmatic rocks from the western Durkan Complex. Normalizing values are from Sun and McDonough (1989).*

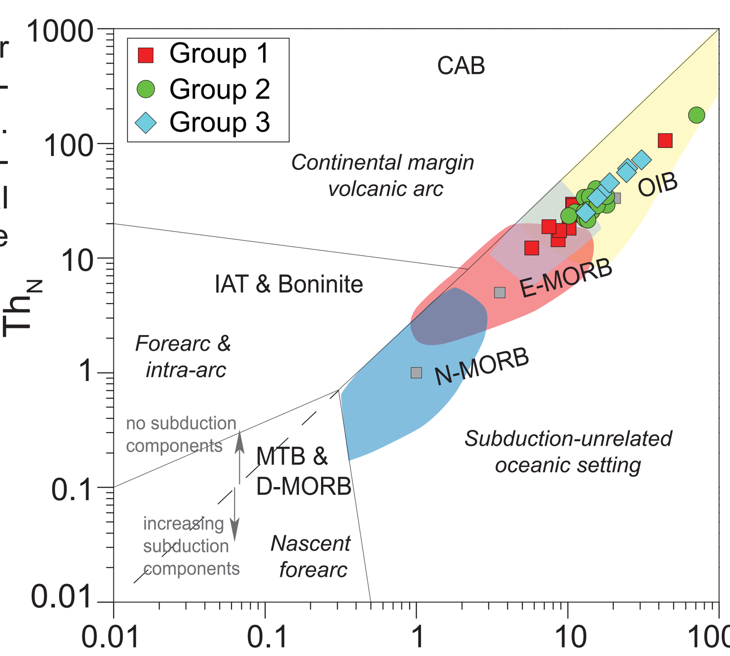

Figure 7 *N-MORB normalized Th vs. Nb discrimination diagram of Saccani (2015)*

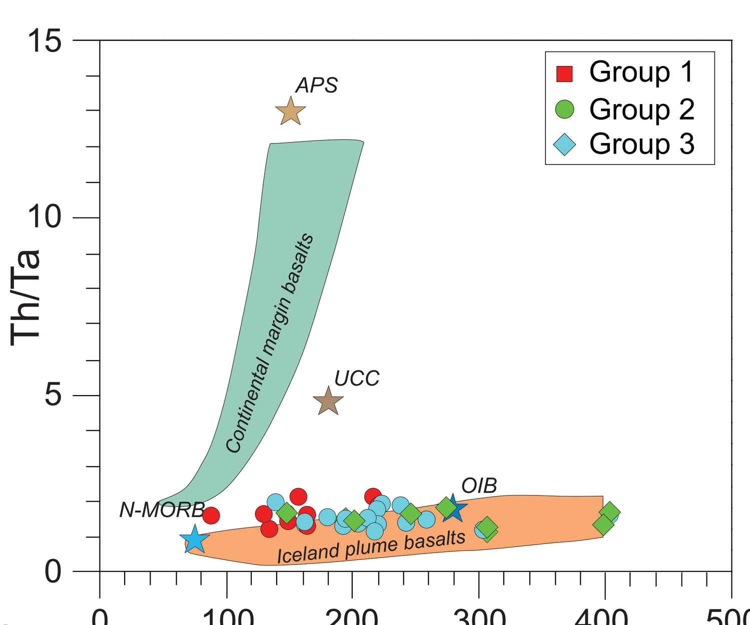

Figure 8 *Zr vs. Th/Ta diagram for the magmatic rocks of the western Durkan Complex*

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