2016 PROJECTS

Raiders of the lost Cretaceous arc (Kurdistan)

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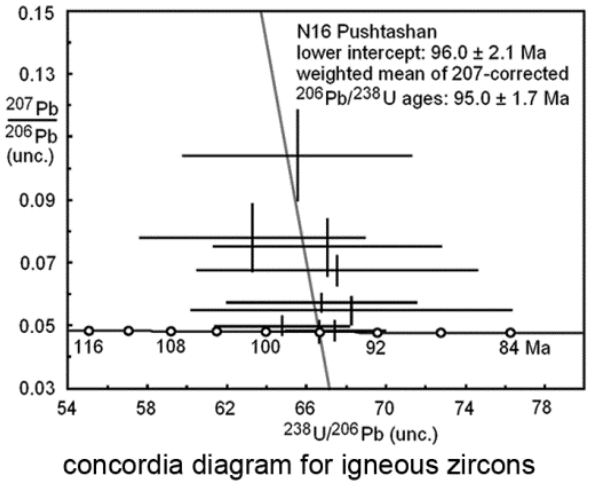
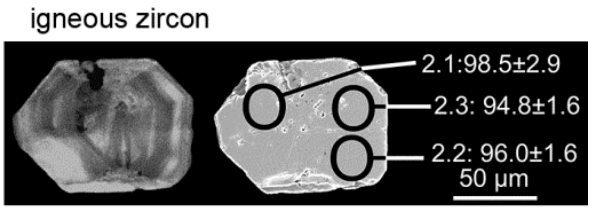
The world's largest ongoing collisional orogeny is the Europe Alps–Himalayan–SE Asian belt and is a natural laboratory to understand many processes that have shaped the continents. Due to political instability and conflict throughout this Millennium, the Iraq (Kurdish) sector of the Zagros mountain chain is the least studied part of this orogenic system. In Iraq the Zagros contains the suture between the Arabian subcontinent to the south and west and the Iranian edge of the Eurasian continent to the north and east. The suture zone is marked by several allochthons of Neotethyan ophiolitic and volcanic arc assemblages that were obducted onto the Arabian margin. New geochronological data, including SHRIMP U-Pb zircon, integrated with whole rock geochemistry, indicates that both Cretaceous (~96 Ma) and Cenozoic (~40 Ma) assemblages are present. This integrated field geology, petrology and geochronology initiative has been supported by several small grants from GeoQuEST, most recently in 2016-2017 by the 'Raiders of the lost Cretaceous arc (Kurdistan)' project. This funding saw some of the last remaining pieces in the jigsaw puzzle of Cretaceous and Cenozoic arc fragments completed. The samples targeted are components of juvenile arcs – where igneous rocks are low in SiO_2, meaning that magmatic zircons are hard to find. As an example below, is shown information on the Pushtashan arc allochthon, which turns out to be Cretaceous in age.





Igneous zircons from a Pushtashan (Iraq) suprasubduction assemblage felsic intrusion have a U-Pb age of 96 Ma, with initial εHf value of +13.9. The assemblage represents Cretaceous intraoceanic juvenile arc crust formed during closure of Neo-Tethys

Summary of zircon data from a felsic vein within the Cretaceous Pushtashan arc allochthon

The accumulating new data indicates that the Iraqi sector of Neotethys was not 'quiet' in the Cretaceous, but contains fragments of arcs of that age, contiguous with those a long strike in Turkey, Iran and the Himalayas. From GeoQuEST support, this has resulted in 2016 in the following 3 papers on specific rock assemblages in Kurdistan:

Ali, S.A., A. Ismail, S.A., Nutman, A.P., Bennett, V.C., Jones, B.G., Buckman, S. (2016). The intra-oceanic mid-Cretaceous (~108 Ma) Kata-Rash arc fragment in the Kurdistan segment of Iraqi Zagros suture zone: Implications for Neotethys evolution and closure. Lithos 260, 154-163.

Aswad, K.J., Ali, S.A., Al Sheraefy, R.A., Nutman, A.P., Buckman, S., Jones, B.G., Jourdan, F. (2016). $^{40}Ar/^{39}Ar$ hornblende and biotite geochronology of the Bulfat Igneous Complex, Zagros Suture Zone, NE Iraq: New insights on complexities of Paleogene arc magmatism during closure of the Neotethys Ocean. Lithos, DOI.org/10.1016/j.lithos.2016.10.013.

Ismail, S., Ali, S., Nutman, A., Bennett, V.C., Jones, B. (2016). The Pushtashan juvenile suprasubduction zone assemblage of Kurdistan (northeastern Iraq): A Cretaceous (Cenomanian) Neo-Tethys missing link. Geoscience Frontiers, 10.1016/j.gsf.2016.11.002

In addition, these papers, and those from several previous years, led to an invitation to contribute a review paper on the Kurdistan arc systems to the journal *Geodynamics*:

Ali, S.A., Nutman, A.P., Aswad, K.J., Jones, B.G. (under review). Overview of the tectonic evolution of the Iraqi Zagros thrust zone: sixty million years of Neotethyan subduction. Geodynamics.

Allen Nutman, 13th September 2017