

Anatomy of an Arc Section: A MASH Zone Revealed

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The Sierra Valle Fertil to La Huerta section of the Famatina arc in west central Argentina exposes the plutonic roots and associated host rocks in a 100 km long nearly continuous section with paleo-depths of >25 km to 8 km or less. This tilted section exposes identifiable end-member components of a juvenile continental arc: large bodies of granodiorite and tonalites in the mid-to-upper crust, a mafic and ultramafic dominated lower crust, which is interlayered with a lithologically homogenous sequence of metapelites and other supracrustal compositions. The circulatory system of the arc is continuous and decipherable: all units described above are physically linked via hyper-solidus and migmatitic domains, veins and dikes that connect source rocks to plutons. The preservation is exceptional as arc magmatism was largely arrested by a soft collision during the prograde peak, before long-lasting magmatism had obliterated the architecture of a complete compositional cycle that occurred over a span of 4-5 Ma. Hence much as volcanic systems are a snapshot of a magmatic system, the Sierra Valle Fertil provides a snapshot of a juvenile, but crustal-scale plutonic system, without significant over-print of high temperature structures and very long-lived repeated magmatic processing.

Of special interest is the engine room of the arc: mafic to ultra-mafic cumulates (pyx, olv, amp, plag) to tonalites. These occur as a composite, heterogeneous, variably cumulate complex up to 15 km thick. The compositional variability is consistent with a fractionation model but one that requires a changing cumulate assemblage (gabbros) reflecting discrete episodes of extraction of daughter magmas (tonalites). Field identification of distinct mafic plutons is difficult as hyper-solidus conditions prevailed throughout the construction of the complex, blending new intrusions of mafic magma with existing cumulate mush. Based on Sr, Nd and O isotopic evidence, assimilation must have occurred, but low-K₂O throughout the complex indicates that extraction of contaminated melts from the gabbroic mush was efficient. However crustal melting, whether of sedimentary host rocks, or mafic precursors, plays a minor role in the production of compositional diversity. Taken together this suggests that the Sierra Valle Fertil mafic complex was an archetypical MASH zone whose processes and products were largely conditioned by the tempo of mantle input.