Arc tempos: cyclicity of intra-arc deformation and associated crustal thickening, material transferring and its implications on the genesis of intermediate magma in the Mesozoic Sierra Nevada, California

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The Mesozoic Sierra Nevada Arc (SNA) in the North America Cordillera records magmatic cyclicity [1]. Its causes and links to other geological processes are long-standing questions. Existing models have emphasized processes in the fore- and retro-arc regions [2] while downplaying the deformational history of the arc itself. Our integrated research of field mapping, geochronology, strain analysis and thermobarometry has led to the recognition of cyclic intra-arc deformation involving significant crustal thickening, rapid material transfer processes and a potential role in the genesis of voluminous intermediate magma.

Field mapping reveals three regional, angular unconformities in the central Sierra whose ages are constrained to 260-300 Ma, 195-185 Ma and 115-132 Ma, that is before or during the early stages of three magmatic flare-ups. The unconformities record episodic intra-arc deformation, erosion, and renewed volcanism/sedimentation. Deformation before and during magmatic surges is evident by the paleo-strain fields restored using structures in both plutons and host rocks indicating periods of co-axial to transpressive contraction during the Mesozoic. These contractional events led to at least 50% shortening and 100% thickening of the arc crust in an approximate plain strain style, which requires arc materials to be transferred vertically. Thermobarometry in plutons, however, indicate that the maximum exhumation of the central Sierra during the Mesozoic is about 7 km and thus requires significant downward transfer of host rocks. Widespread field evidence is observed of this downward transfer with estimates of associated strain rates at 10^-15 to 10^-14 1/s, more rapid than the strain rate of the retro-arc deformation. The downward transported host rocks into mantle lithospheric depths would fertilize the magma source regions and sustain the productivity of voluminous intermediate magma during flare-ups and would transform to eclogitic phase in the lower crust. We propose that the arc itself is a very dynamic environment with multiple feedbacks linking various intra-arc tectonic-magmatic processes that potentially play an important role in regulating the arc tempos in the board scale.

[1] Ducea, M (2001), *GSA* Today **11**, 4-10 [2] DeCelles *et al* (2009), *Nature Geoscience* **2**, 251-157