Abstract ID: 190

Title: THE END OF DETACHMENT FAULTS, WITH APPLICATIONS TO PORPHYRY COPPER SYSTEMS IN SOUTHERN ARIZONA

Student: No

Topic: Economic Geology

Medium: Invited Oral Presentation

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Keywords: Porphyry copper, normal faults, core complexes, detachment faults

Abstract: A new model for crustal extension and the origin of Cordilleran metamorphic core complexes has implications for reassembling and exploring for dismembered porphyry copper systems. Normal faults occur in sets of subparallel faults that are only slightly listric, initiating with dips of ~60° and rotating to lower angles as they move. The amount of rotation of fault blocks is not primarily governed by fault curvature. Reconstructions that honor geologic constraints indicate that faults of a given set moved penecontemporaneously. Faults change with depth from brittle faults to mylonitic shear zones, ultimately merging into a zone of ductile stretching, mid-crustal flow, and intrusion, without any intervening faults, such as gently dipping "detachments" or subhorizontal "decollements." The mid-Tertiary faults have analogs in active normal fault sets in the modern Basin and Range.

Each set of subparallel faults creates a complex half graben, which defines a narrow rift that widens with time. Fault sets associated with periods of rapid extension have more numerous, closely spaced faults. To maintain structural balance and to meet other constraints, material continuously flows to beneath the active half graben from surrounding areas broadly concurrent with brittle faulting.

After faults rotate from ~60° to ~20-30°, they become inactive. If regional extension continues, a new set of faults forms, defining a new half graben. Where half grabens spatially overlap, faults associated with a younger half graben cut cleanly across older faults; therefore, geometrical "sets" also constitute temporal "generations." Even if faults of new and old generations have a similar strike, they may dip in opposite directions. Faults in older generations are rotated passively by movement on younger faults. Older faults may continue to rotate to lower dips or may be back-rotated toward their original, steep dips.

Formation of features recognized as "core complexes" probably requires both extreme amounts of extension and fault sets with opposing dips. The brittle faults in the upper plate of the "detachment" fault formed during early half grabens and are cut off by the "detachment," rather than merging with it. Fault sets that define the "detachment" are normal faults that initiated at ~60° during formation of an intermediate-stage half graben.

Faults that cut the “detachment” are associated with the youngest half grabens. Rarely do faults have displacements that exceed 3-4 km. Offsets of geologic markers by tens of kilometers represent net displacement on many faults.

Laramide porphyry copper systems affected by Tertiary extension may by highly dismembered, with multiple levels of the system preserved, though generally not in a simple progression at the present surface from shallow to deep levels. The San-Manuel-Kalamazoo deposits, the Little Hill mine, and the Chirreon Wash pluton may be fragments of the same system formed at ~ 69 Ma, strung out over a distance of >50 km.