Correlation of Earthquakes with Faults along the Southwestern Margin of the Colorado Plateau, Northern Arizona

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The Northern Arizona Seismic Belt (NASB) is one of the most seismically active areas in Arizona, and extends from near Kanab in southernmost Utah to the Mogollon Plateau south of Flagstaff, Arizona. Overall, seismic activity in the southwestern Colorado Plateau is low to moderate although three earthquakes with magnitudes of ~6 were reported in the NASB between 1906 and 1912; consequently, the seismicity of this area has not received extensive attention. Faults in our current study area north of the Grand Canyon in Arizona include the Toroweap-Sevier, West Kaibab, Paunsaugunt and Big Springs faults (Brumbaugh, 2008, JGR v. 113, B05309). Of these, only the Toroweap fault has documented Holocene displacement (Quaternary Fault and Fold Database of the United States, http://geohazards.usgs.gov/qfaults/map.php). Jackson (1990, cited in Brumbaugh, 2008) indicates displacement on the Toroweap fault within the last 4000 years.

Brumbaugh (2008) constructed focal mechanism solutions for four earthquakes with local magnitudes of ≥ 4 within the NASB: M5.75 on 7/21/59; M4.5 on 2/15/62; M4.4 two hours later on 2/15/62; and M4.0 on 4/26/91. No ground-surface fault ruptures were observed for any of these events. The M4.4 event of 2/15/62 was located in the vicinity of the Toroweap fault, the epicenter of the 1959 event was located near the West Kaibab fault, and the epicenter of the 1991 event was located near the Big Springs fault. The epicenter of the M4.5 event of 2/15/62 was located south of Fredonia, Arizona, but not near any mapped fault to our current knowledge. All four events have normal or normal-oblique focal mechanism solutions.

Nodal planes from each of these earthquakes were projected from the reported focus to the ground surface (represented by a DEM), with allowance for vertical and horizontal location uncertainties. The result for each earthquake was a pair of mapped swaths or seismo-lineaments (Cronin et al., 2008, Environmental and Engineering Geoscience, v. 14, p. 199-219). For each event, the ground-surface trace of the fault that generated the earthquake might be expected to be located within one of the two swaths, while the other would be associated with the auxiliary plane of the focal mechanism. Geomorphic analysis within the seismo-lineaments was conducted using low-elevation illumination directed perpendicular to the swath trends. Initial indications based on the geomorphic analysis and existing fault maps are that the seismo-lineaments might contain the faults that generated these events. Fieldwork to test these hypotheses, by comparing the orientation of fault surfaces and slip directions observed in the field with the orientation and slip data from the corresponding fault-plane solution, is to be conducted between the submission date of this abstract and the presentation date.

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