Lineament Analysis of the Proposed Pocatello Segment of the Wasatch Fault, SE Idaho

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Abstract

The Wasatch fault consists of ten fault segments that collectively extend from Fayette, Utah to north of Malad City, Idaho. On the basis of field mapping, researchers have proposed an 11th Wasatch fault segment which would extend the Wasatch fault zone from north of Malad City to Pocatello, Idaho. This study analyzes 10 meter digital elevation model (DEM) data acquired from the United States Geological Survey’s (USGS) National Elevation Dataset (NED) to test this hypothesis. Hillshade was derived from 10m DEM to display prominence of the Pocatello segment. ESRI ArcMap 10.2 and GIS data were used to document the significant lineament feature that correlates with the proposed Pocatello segment of the Wasatch fault zone, 70 km north of its previously recognized terminus. Lineament analysis supports the extension of the seismically active Wasatch normal fault zone northward to Pocatello, Idaho. Based upon our analysis, we propose that: 1) lineaments clearly identify a conspicuous feature that correlates with the proposed Pocatello fault segment.

2) the Wasatch normal fault continues at least 70 km northward beyond its previously documented northern terminus in Malad City to Pocatello, Idaho; 3) the Pocatello segment has the potential to generate greater than M 6 earthquakes in southeastern Idaho, as has been observed to occur to the south in Utah and to the north in Borah Peak Idaho.

Three-dimensional view of Wasatch fault with 5x exaggeration. Red indicates greater elevations, green indicates lower elevations.

USGS Landsat Thematic Mapper 5 image of Wasatch fault. Image bands displayed 7, 4, 1 (RGB) at 30m resolution.

USGS Landsat Thematic Mapper 8, pan-sharpened image of Wasatch fault. Image bands displayed 7, 4, 1 (RGB) at 15m resolution.

Note the central & southern Wasatch fault segments have ruptured within the past 2,000 years. The northern fault segment (Boiseham City & northward) have not experienced surface rupture in over 2,000 years. Northern segments therefore have the greatest elapsed time since last surface rupture. The northern Wasatch segments are overdue with respect to their predicted recurrence interval and are most likely to rupture (Personius et al., 2012; DuRoss et al., 2012).

Regional map of Wasatch fault and surrounding faults.

Velasco’s interpretation of an E-W seismic line of Wasatch Fault near Salt Lake City. Velasco (2009) interprets the regional listric normal fault detachments as reactivated Sevier thrust faults. Detachment includes ramps and flats and becomes subhorizontal at depths of ~10 km. This study documents the continuation of this reactivation structure imaged by Velasco (2009) northward to Pocatello, Idaho.

View of the Wasatch region displaying the linear link of WFE.

View east of west-dipping WFE on west side of Scout Mountain at Garden Creek Gap. WFE displaces east-dipping Proterozoic quatzites in footwall against Cambrian-Silurian rocks hanging wall, with at least 6 km of stratigraphic throw.

View south towards Elkhorn Peak, Wasatch fault west dipping.

CONCLUSIONS

1. Lineaments correspond with faults mapped in the field from north of Malad City to Pocatello, Idaho.
2. Stratigraphic throw of ~6 km across the Pocatello segment fault indicates significant displacement.
3. Pocatello segment may constitute reactivated Paris thrust fault.
4. M7 earthquakes have occurred on Wasatch fault segments within the past 6,000 years.
5. M7.3 earthquake occurred in Borah Peak in 1959.
6. Northern segments of Wasatch fault are predicted to rupture.
7. Pocatello segment can produce M7 earthquakes & represents a significant earthquake hazard.
8. Precursor seismic events occurred May 6, 2013 in Lava Hot Springs.

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