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Identification of Quaternary faults in southwest Western Australia using DEM-based hill shading

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In Australia, the extreme infrequency of large earthquake events means that the historic record of seismicity is poorly suited to the task of assessing seismic hazard. Paleoseismological investigations provide the only viable avenue to obtain constraints on the recurrence intervals of large and damaging earthquakes. However, the prehistoric record is compromised by difficulties related to finding direct evidence for large earthquakes (e.g. fault scarps), which may be subtle or relatively short-lived in the landscape. In recent times, high resolution digital elevation models (DEMs) have emerged as an important tool for defining and mapping of areas of probable elevated earthquake hazard. Unlike airphoto interpretation, shaded-relief images derived from DEMs may be used to enhance lineaments by simulating topographic illumination from a variety of light azimuths and elevations.

An examination of a 10 m resolution Western Australia Department of Land Administration (DOLA) DEM and selected Shuttle Radar Tomography Mission (SRTM) 3 second DEM tiles forming a buffer around the DOLA data has resulted in the identification of thirty-three previously unrecognised fault scarps of probable Quaternary age in the southwest and central west of Western Australia. The new features bring the total number of Quaternary tectonic features in the area to sixty. The scarps range in length from $\sim$15 km to over 45 km, and from $\sim$1.5 m to 20 m in height. They are all roughly northerly-trending, and most of the scarps where a dip direction has been established from the DEM data reflect reverse displacement on the underlying fault (consistent with the compressive E-W crustal stress field inferred from *in situ* and earthquake-derived stress data). The spatial distribution of scarps is roughly uniform (implying uniform strain distribution across the craton), and many, if not most, of the scarps are *not* associated with contemporary seismicity (suggesting that strain

release at longer time scales (e.g. hundreds to thousands of years) is migratory and large earthquakes are episodic within any given area).

The inventory of features identified provides important clues to the crustal deformation mechanisms extant in cratonic shield areas, and hence constraints for models describing intra-cratonic deformation and seismicity. While recurrence information for large earthquakes associated with individual scarps is necessary to provide some certainty in seismic hazard assessments for short return periods (e.g. one in 475 year event), the data presented here identify ‘earthquake prone’ regions that could be employed as a basis for further investigation. Furthermore, the data are suitable for immediate application to hazard assessments for longer return periods (e.g. the one in 20,000 year event that might be designed for in the case of dams), and as a constraint for crustal strain models.