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Isothermal thermoluminescence dating of K-feldspar from sediments to determine fault slip rates: development and assessment

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Faults in California accommodate most of the relative motion between the Pacific and North American tectonic plates, along either one main strike-slip fault, – the San Andreas fault – or a network of sub-parallel faults (e.g., the San Jacinto, Elsinore and San Andreas faults). Slip is also accommodated along many other associated faults and folds, and the region suffers frequent damaging earthquakes. Contemporary movements of different fault-bounded blocks are relatively well established on decadal timescales using remote sensing and GPS, and on timescales of 10^6 to 10^7 years, by dating offset geologic features with radiometric methods. However, on timescales of decades to several hundred thousand years, determining total fault offset and mean slip rate is harder. Critical questions for understanding fault dynamics and improving earthquake risk assessment include the degree to which slip is clustered into episodes of more rapid movement, and how slip is accommodated by different sub-parallel faults. In many cases, streams with offset courses can be recognised, and in some cases offset terrace surfaces can be located, especially when using LiDAR data to complement field mapping. Radiocarbon and terrestrial cosmogenic nuclides have been used to date these features, but both have limitations of age range, sample suitability and availability. OSL (optically stimulated luminescence) and IRSL (infra-red stimulated luminescence) have great potential to complement these techniques, though the characteristics of quartz in some parts of southern California are suboptimal, displaying low sensitivity and other limitations. In order to overcome these limitations encountered using quartz OSL, we are developing a new geochronometer based on the isothermal thermoluminescence (ITL) signal of K feldspar measured at 250°C. Preliminary ITL age estimates from the paleoseismic site of El Paso Peaks on the Central Garlock fault in the Mojave Desert, California, agree well with a well-established radiocarbon chronology based on 29 samples spanning the last 7,000 years (Dawson et al., 2003). We examine the basis of this new ITL approach and assess its potential for application within California and beyond.

Reference cited

Dawson, T.E., McGill, S.F. and Rockwell, T.K. 2003 Irregular recurrence of paleoearthquakes along the central Garlock fault near El Paso peaks, California. Journal of Geophysical Research 108, No. B7, 2356, doi:10.1029/2001JB001744.