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Assessment of radiated P and S wave energy from shear and tensile picoseismicity in the Mponeng deep gold mine, South Africa

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We investigate the S-to-P radiated energy ratio (E_S/E_P) of picoseismic and nanoseismic activity (M_W>-4.1) following the M_W1.9 earthquake recorded in the Mponeng deep gold mine, South Africa. More than 25000 aftershocks were recorded during 6 days by the JAGUARS (Japanese–German Underground Acoustic Emission Research in South Africa) high-frequency seismic network. The network is composed of 8 acoustic emission sensors (sensitivity 1 kHz-180 kHz) and 3-component accelerometer, located only 30 m from the main event. Here, we extend previous studies on source scaling relations (cf. Kwiatek et al., BSSA 100(3), 2010; BSSA 101(6), 2011) and analyze the E_S/E_P ratio of about 500 high-quality aftershocks in order to determine the character of faulting (shear/tensile/mixed). In cases where the moment tensor solutions are not available, low E_S/E_P ratio may be a signature of tensile faulting. However, the observed values of E_S/E_P ratio may also be biased due to path effects and the way energy is radiated from the source (radiation pattern, directivity). In our study, we investigate the influence of attenuation and the radiation pattern on calculations of E_S/E_P ratio and consider two end-member cases: pure shear faulting and pure tensile faulting. The obtained results suggest that the majority of events display a significant tensile component.