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Graphite lubrication in major orogens: heat mapping the Porsa Imbricate Stack (Norway) using a handheld Raman spectrometer

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A novel handheld Raman spectrometer was employed to characterise graphitisation of carbonaceous slates in the Porsa Imbricate Stack (PIS), part of the Repparfjord Tectonic Window in Northern Norway. Basal plane slip within graphite potentially acts as a lubricant during faulting, causing imbrication to take place in abnormally low temperature regimes. In order to compare the PIS with similar imbricates, RSCM (Raman Spectroscopy on Carbonaceous Matter) was used to constrain peak metamorphic temperatures. During an eight-day field trip, lithological data was collected in a 8 km^2 area and 284 spectra were measured at 56 localities, 238 of which had acceptable signal-noise ratios. As automated peakfitting would reduce operator bias and processing time for data sets of such size, a Matlab (R2017a) code was written. This code compares temperature correlations by Rahl et al (2015) and Aoya et al (2010). Between these, a strong linear correlation was found, but with temperatures differing by more than a 100 °C in structurally deeper areas. The derived temperature gradient was comparable to a normal continental gradient (30 °C km^{-1}) or slightly hotter, with temperatures increasing southwestwards. The area with the thinnest thrust slivers corresponds to emplacement above 545°C, whereas thicker Kvalsund Formation carries thrust slices below 500 °C. At these temperatures, graphite may well gain lubricative character and act as a significant lubricant in crustal processes. This study highlights calibration issues of RSCM studies and underscores both the power but also potential limitations of using a portable spectrometer.