Influence of the sepiolite and palygorskite crystal structure and microstructure on their frictional properties and behaviour in fault zones

CATALINA SANCHEZ-ROA[1], JUAN JIMENEZ-MILLAN[1*], FERNANDO NIETO[2], DANIEL R. FAULKNER[3] AND ROSARIO JIMENEZ-ESPINOSA[1]

[1]Department of Geology and CEACTierra, Associated Unit IACT (CSIC-UGR), University of Jaén, Campus Las Lagunillas s/n, 23071 Jaén, Spain (catasroa@ujaen.es; *correspondence: jmillan@ujaen.es; respino@ujaen.es)

[2]Department of Mineralogy and Petrology, Faculty of Science, University of Granada, Avda. Fuentenueva s/n 18002, Granada, Spain (nieto@ugr.es)

[3]Rock Deformation Laboratory. Dept. of Earth, Ocean and Ecological Sciences. University of Liverpool. Liverpool, UK (faulkner@liverpool.ac.uk)

We have performed frictional sliding experiments on powdered, pure standards of sepiolite and paligorskite and fault rocks from the Galera fault zone (Betic Cordillera, S of Spain) rich in these minerals and smectites in order to establish the frictional behaviour of fibrous phyllosilicates as compared with other platy clay minerals. The friction tests were carried out on a triaxial deformation apparatus with a servo-controlled axial loading system and fluid pressure pump in the Rock Deformation Laboratory in the University of Liverpool. Friction coefficients for palygorskite and sepiolite as monomineralic samples (under vaccum and open atmosphere conditions) show a friction coefficient of 0.65 to 0.7 for dry experiments and between 0.45 to 0.5 for water saturated experiments. Despite the fact that sepiolite and palygorskite are part of the phyllosilicates group, their mechanical behaviour is different, showing a higher frictional behaviour than platy clay minerals which vary between 0.22-0.44 for dry tests and between 0.12-0.38 for wet experiments. The difference in frictional behaviour could be explained by the difference in the structure of these fibrous minerals. The inversion of the apical oxygen makes the structure stronger and the water layers discontinuous, allowing the shear to be localized more within the TOT layers and less in the water layers. Meanwhile, in platy clay minerals the shear is concentrated in the water layers that allow the TOT structures to slide easily. Constraining the genesis conditions and factors that favour precipitation of platy/fibrous phyllosilicates could help us understand the general role of fault weakening from clay neomineralization.