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Squeezed Under the Sheet: White Mica Records High Tectonic Stresses Within a Decollement Thrust

Miisa Häkkinen¹, **Samuel Angiboust**¹, Benoit Dubacq², and Martine Simoes¹

¹Université de Paris, Institut de Physique du Globe de Paris, France (angiboust@ipgp.fr)

²ISTEP, Sorbonne Université, Paris, France

Tectonic stresses at the base of decollement thrusts are generally expected to be low due to the presence of mechanically weak evaporites. Yet, the presence of abundant micro-seismicity in the region expected to correspond to the evaporitic layer remains paradoxical. We study here a fossil thrust zone from the base of the Digne nappe (SE France) where exotic thrust slices formed by brecciated Paleozoic basement micaschists are observed within the Mio-Pliocene decollement. Petrographic investigations reveal the presence of highly-substituted phengitic rims (up to Si=3.43 apfu) around pre-alpine muscovitic cores. Similar micaschists sampled in a basement high further North do not exhibit these phengitic rims around muscovite, thus suggesting that white mica zoning relates to a younger overprint. Such high-Silica phengites are commonly found in high-pressure terranes (i.e. 7-15 kbars depending on the buffering assemblage) but are not expected in foreland regions, such as in the Digne area where the overburden has never been thicker than c.5km (i.e. approximately 1.3 kbar). We propose that the mica zoning observed reflects the former presence of non-lithostatic stresses (possibly on the order of several kilobars) related to the elastic charging of a thrust slice “squeezed” at the base of the moving nappe. This finding sheds light on stress distribution as well as on the origin of micro-seismicity along active decollement thrusts in orogenic belts.