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Comment on se-2020-221

Henrik Friis (Referee)

Referee comment on "Rock alteration at the post-Variscan nonconformity: implications for Carboniferous-Permian surface weathering versus burial diagenesis and paleoclimate evaluation" by Fei Liang et al., Solid Earth Discuss., https://doi.org/10.5194/se-2020-221-RC2, 2021

This paper presents a very instructive and convincing example of two successive weathering events followed by diagenetic modifications. The study is well performed and presented and gives an overall impression of reliable data, discussion and conclusions.

The study includes a petrographic and a geochemical approach. In many such studies – as is also the case in this one – there is a problem in combining the petrographic evidence with the geochemistry. The petrography gives a very convincing information on the intensity of the weathering events, but when it comes to the geochemistry, the information seems to be strongly blurred by the much later diagenesis. The most common geochemical parameters for identifying the weathering intensity are CIA and PIA. Both suffer from uncertainty in estimating the loss of K (CIA) and Ca (CIA AND PIA). In this study there is an increase in K_2O compared to the protolith which seems to be well identified in both cases, and the authors have decided for "no loss" during weathering by choosing the K-value of the protolith for the CIA diagram (the equation used for K_2O_{corr} does not add any information as it can simply be reduced to K_2O_{corr}=K). Without a reliable estimate for K-loss during weathering, an important aspect of the study is lost. Similarly, Ca-loss cannot be well established when calcite and dolomite are present. At least the evaluation of the Ca-content should be made in the light of the presence of carbonates rather than apatite. The chois in this study has been to assume that Ca must be lower than Na.

The study concludes – with strong support from petrography – that the weathering resulted in formation of smectite, and that this smectite was (much) later transformed to illite as a result diagenetic transfer of K. But then: how did diagenesis influence the content of Na and Ca – the other key elements in relation to evaluation of weathering intensity. Was K lost during weathering and just more than fully replied during diagenetic transfer - or was it partly consumed by the illitic interlayers in the smectite – or simply not released from primary minerals in the protolith? Was Na and possibly some Ca consumed by smectite formation and only released as respond to the diagenetic illitization (transfer of K)? Or were they already lost by leaching during weathering?

Since the evaluation of weathering intensity is discussed in relation to geochemical loss of elements the above aspects should be discussed in more detail