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Volcanic origin of K-bentonite: criteria from zircons

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Zircon crystals were examined in order to assess the volcanic origin of three K-bentonites of late Frasnian age. The levels L3 and L6 were sampled in the Lion quarry (Frasnes-lez-Couvin, Belgium). They belong to the lower *rhenana* conodont zone. The SS layer, from the Steinbruch Schmidt quarry (Germany), belongs to the upper *rhenana* conodont zone. These three K-bentonites are 1 to 5 cm-thick, ochre-yellowish in colour. By their clay mineralogy, they differ markedly from the country rocks, giving rise to spikes of illite and illite-smectite mixed-layers and being deprived of both kaolinite and chlorite, which attests of their K-bentonitic nature.

With the help of SEM imaging we have studied zircon crystal shapes, based on populations of hundredths of crystals for each level. Extracted zircon crystals have diameters never exceeding 125 μm (mesh size). Such a size range is suggestive of an aeolian deposition for the three K-bentonites.

Whereas L3 and L6 contain euhedral zircons and frequent crystal groupings, the SS zircons are rounded and slightly corroded, with somewhat smoothed edges. In L3 and L6 K-bentonites, the dominance of euhedral zircon crystals indicates aeolian transport, while corroded zircons of the SS K-bentonite might have endured a longer erosional history.

Crystal shapes were classified following Pupin (1980, Contrib. Min. Petr.) based on the link between relative development of the families of crystal faces. L3 zircons show J- and D-type shapes. J-types correspond to crystals with one prism (100) and two pyramids (211) and (101), while D-type crystals have only one prism (100) and one pyramid (101). Lion 6 zircons show P-type shapes, with two prisms (100) and (110)

and one pyramid (101). SS zircons have shapes of various S-types, i.e. two prisms (100) and (110) and two pyramids (211) and (101) with variable relative development. While J-, D-, and P-type zircons are usually found in volcanic rocks, S-type zircons are rather indicative of plutonic rocks. As a whole, the shape characters of the zircons are in favour of a volcanic origin for L3 and L6 K-bentonites. By contrast, the SS K-bentonite zircons might be originated from the erosion of an exhumed calc-alkaline pluton.

In conclusion, it seems that prior to zircon U-Pb dating, inexpensive shape and size studies of zircon are a required check: are zircon crystals really of volcanic origin? The technical difficulties and the rather old age encountered by Kaufmann et al. (2004, J. Geol.) during U-Pb dating of SS zircons might suggest that the dated material was not adequate for event-dating.