Recognizing pedogenic features in Paleogene sandstones and silcretes in Belgium. A key-feature for paleoenvironmental and sourcing material studies

Jean-Marc Baele, Veerle Cnudde, Christian Dupuis, Florence Quesnel, Caroline Ricordel-Prognon, Isis Veldman

Recognizing pedogenic features in Paleogene sandstones and silcretes in Belgium. A key-feature for paleoenvironmental and sourcing material studies.

Session 16i

156

Baele J.-M.[1], Cnudde V.[2], Dupuis C.[1], Quesnel F.[3], Ricordel-Prognon C.[3], Veldman I.[4]

1 UMons, Faculty of Engineering, Dept of Geology, Mons, Belgium

2 UGent, Faculty of Sciences, Dept. of Geology and Soil Science, Belgium

3 BRGM (French Geological Survey), Geology / Regolith and Reservoir, Orléans, France

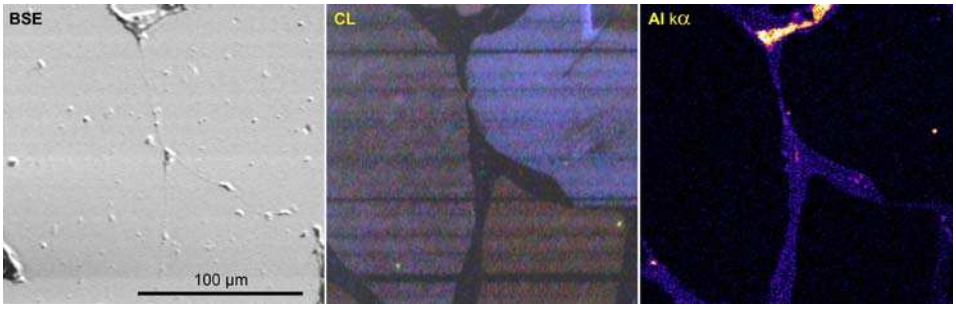
4 Kijnigstraat 1, 2250 Olen

A few sandstones occurring in Belgium, especially those from Paleogene strata, share many common features with pedogenic and groundwater silcretes documented in the Paris Basin in France, in South Africa and in Australia (e.g. Thiry, 1999; Summerfield, 1983; Webb & Golding, 1998,). Here we present a review of the criteria that may be used to assess the pedogenic (or "groundwater") origin for sandstones and silcretes.

At field scale, pedogenic features in silcrete often consist in the development of vertical (columnar) or nodular structures and/or layers (horizons) due to vertical percolation (illuviation) and transformation of materials in the profile porosity and cracks. Groundwater silcrete often exhibit a typical mammilated surface (e.g. Nash & Ullyot, 2007). Root and rootlet casts, sometimes with silicified root or wood material, also indicate that the rock evolved at the surface or near-surface.

At microscopic scale, illuviation of silt and clays in the vadose or water-table environment results in the formation of a series of finely-laminated coatings and infillings. These pedofeatures consist in "typic", "crescent", "capping", "pendent", "micropan" and "crust" coatings (Bullock et al., 1985). Irregular rounded structures or "glaebules" also develop as well as micro-columnar or prismatic textures. Many of them have been observed in pedogenic silcretes around the world (e.g. Thiry, 1999) but also in Paleogene silcrete in Belgium (e.g. Veldman et al., in review). Of particular importance is the concentration of fine-grained titanium-oxides in pedogenic silcrete. These Ti-oxides most probably originated from the weathering of clay material and were concentrated via the same pedogenic processes which concentrated silica in the silcrete profile (Thiry, 1997).

In sandstones with a pure sand matrix, where no or few fine-grained material is available for illuviation, assessing the pedogenic origin for the silicification is much more difficult based solely on microtextural observations. New perspectives may arise from trace-element analysis in the quartz cement overgrowing the grains. For example, combining cathodoluminescence imaging (CL) and electron microprobe analysis (EPMA) allowed the detection of abnormally-high concentration of Al and K in the quartz cement relative to the quartz grains in the Grandglise Thanetian sandstone in the Mons Basin (figure). This suggests that first the weathering of glauconite, which is actually observed here, is the likely source for silica and secondly, the evidence for aluminum migration would indicate strongly acidic conditions in the pore fluids.



Back-scattered electron (BSE), cathodoluminescence (CL) and X-ray map of Al kα of quartz cement in the Grandglise sandstone (Thanetian).

Bullock P., Federoff N., Jongerus A., Stoops G., Tursina T. and Babel U. (1985). Waine Research Publications, Wolverhampton, 152 p.

Nash DJ. & Ullyott JS. (2007). In Geochemical sediments and landscapes, Ed. Nash DJ. & McLaren SJ., 95-143.

Thiry M. (1997). In Continental silicifications: a review, Ed. Paquet H. & Clauer N., Springer, 369 p.

Thiry M. (1999). Spec. Publs int. Ass. Sediment. 27, 87-127.

Veldman I., Baele JM., Goemaere E., Deceukelaire M., Dusar M. and De Doncker HWJA (in review). Journal of Geophysics and Engineering.

Summerfield MA. (1983). J. Sed. Petrol., 53, 895-909.

Webb JA. & Golding SD. (1998). Journal of Sedimentary Research, 68, 981-993.