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# Mineralogical and $\delta^{18}$o-$\delta$D isotopic study of kaolinized micaschists at Penestin, Armorican Massif, France: New constraint in the kaolinization process

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Many kaolinite occurrences developed from Paleozoic rocks forming the basement of the Armorican Massif in western France [1, 2]. Their origin, hydrothermal alteration and/or weathering, is still discussed [2, 3]. In order to provide new constraints to this debate, we studied the kaolinite occurrence at Penestin in the southern part of the Armorican Massif, using several approaches, including field and petrological observations, mineralogical analyses (XRD) and stable oxygen-hydrogen isotope analyses.

An alteration profile was developed from faulted micaschists showing, from the bottom to the top of the profile, a reddish saprolite zone with pure white kaolinite fissures cutting across the schistosity and a white kaolinite zone, 5-10 meters thick (Figure 1).

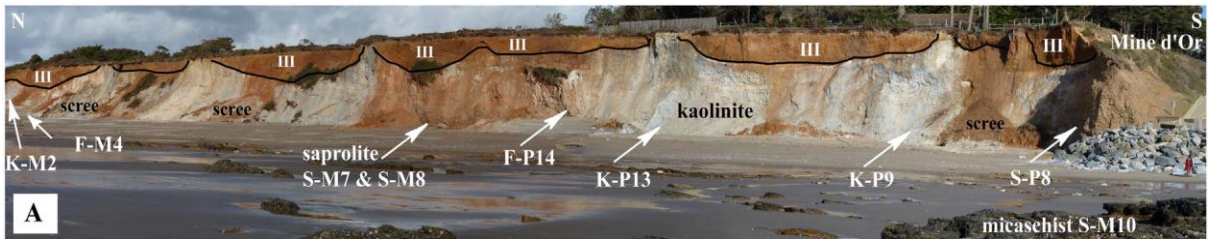


*Figure 1: 500 m long, ~15m high coastal cliff, north of La Mine d'Or beach entrance, where micaschist is cropping out on the shore, saprolite is located at the cliff toe in different patches and the white kaolinite zone is cropping out in a relatively continuous way with a thickness of about 5–10 m. The top of the kaolinite zone is crosscut by an unconformity surface covered by Miocene to Pleistocene red clastic sediments (III) and Quaternary deposits. S–M#, K–P# and F–M# are locations of analyzed samples.*

The detailed study by XRD of the layer silicates enabled us to characterize a mineralogical sequence with increasing alteration intensity, which is coherent with a weathering evolution: mica, chlorite to illite/vermiculite (chlorite) mixed-layer mineral to vermiculite to vermiculite/kaolinite mixed-layer mineral to kaolinite. Moreover, an intense iron leaching process occurs within the kaolinite zone, which is characterized by a bleaching of this zone combined with iron oxyhydroxide precipitation along/within fractures and cracks. The isotopic analyses of kaolinite from the zone and fissures gave $\delta^{18}$O values ranging from 19.64 to 21.21 ‰, and $\delta$D values ranging from -69.4 to -65.8 ‰. This confirms that kaolinite was formed by low-temperature water–rock interactions in contact with meteoric fluids during weathering processes.

Isotopic and stratigraphic data suggest that this weathering occurred before the Messinian (~7 Ma) and probably dates back to the Eocene, during which the climate was sub-tropical at this location [4].

*References:*

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