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Occurrence of tosudite in Guezouman, Tarat and Tchirezrine 2 formations, hosts of uranium deposits in Niger (Tim Mersoï basin)

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Several uranium deposits have been discovered since 1958 in the Tim Mersoï basin, near the major regional N-S fault of Arlit-In-Azawa. Both Carboniferous formations of Tarat and Guezouman, deposited in fluvial environment, host uranium deposits which are exploited respectively by the SOMAÏR and COMINAK mining companies. Imouraren deposit, not yet exploited, occurs in the Jurassic fluvial formation of Tchirezrine 2. All these fluvial formations consist mostly of sandstones with a detrital mineralogy composed of quartz, microcline, orthose, albite and some accessory minerals as muscovite and zircon.

In all these formations, the burial siliciclastic diagenesis results in the neoformation of Fe-rich chlorite from berthierine precursor, quartz overgrowths allowed by pressure solution features, kaolinite from destabilization of detrital feldspars and at higher burial conditions, evidence of kaolinite to dickite transformation. In addition, Carboniferous sandstones can present also an early diagenetic cementation of dolomite and the Jurassic formation shows the additional presence of analcime formed from destabilization of volcanic materials (ash), albite overgrowths and illite.

Subsequently to the burial diagenetic stage, the sandstones of the Guezouman, Tarat and Tchirezrine 2 formations suffered a distinctive alteration in response to fluids circulations at a regional scale, which led to partial dissolution of some pre-existing Al-bearing minerals and crystallization of secondary minerals (tosudite, montmorillonite, hematite, harmotome, calcite) and deposition of a part of uranium (uraninite, coffinite, uranophane and metatyuyamunite).

Tosudite, a regular interstratification of chlorite-smectite is one of the secondary minerals formed during this later alteration event from the destabilization of detrital feldspars, kaolins and chlorite. X-ray diffraction patterns of this mineral show a sharp superstructure at 29 to 29.6 Å in air-dried condition which swells at 30.8 to 31.6 Å after ethylene glycol solvation. 060 reflection at 1.507 Å which indicates a dioctahedral global behavior and the very low coefficient of variation (0.03 to 0.13) for (00l) harmonic reflections permit the name tosudite. Chemical micro-analyses allow to identify a low-charge montmorillonite and a sudoite (di-trioctahedral chlorite) as the two components involved in the interstratification. Scanning electron microscope observations show that tosudite is closely associated to uranium minerals and can be considered as a good marker of uranium deposition in the Tim Mersoï basin.