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Paleomagnetic Record of Fault activity - Natural analogue in Utah (USA)

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A paleomagnetic study on fault related travertine's has been led. Travertine may record the complex fluids migration from deep reservoirs to the surface in some faulted zones. In order to evaluate and quantify the episodic opening and sealing of faults above a natural CO2 reservoir, in Green River area, Utah, we investigate some of the thermogenic travertine structures.
It is well known that fluids flow through faults but it is also demonstrated that fault zones may act as impermeable barriers. Here we consider that active faults can be successively considered as open and close paths for fluids. These cycles can be recorded close to the surface by travertine precipitations.
Recurrence and duration of the characteristic times may be evaluated with paleomagnetic tools on carefully sampling. In fact, field and petrographic works reveal the complexity of travertine structures. Two main types of travertine precipitation have been found: travertine built at surface and cross-cutting veins, each of them characterized by different crystallization modes and processes. A paleomagnetic study on a cross section without considering this parameter will lead up to false results regarding fault activity chronology.
We give here results for cross sections sampled over two travertine structures built at surface: 1) an older travertine located on Salt Wash Fault (SWF) and 2) a young travertine located on Little Grand Wash Fault (LGWF). The two structures are located 4 miles away one from the other, upon the same anticline, and directly above normal fault traces. In the first case, the magnetite concentration is high, about 100 ppmv, five score times more than in the second case. Furthermore the magnetic components give a perfect ChRM. Two magnetic inversions are recorded during the travertine formation indicating age of more than 760 ky and several events of travertine construction at the same place. In the second case, the analysis on the travertine show a stable ChRM over the entire 10m-thick outcrop. Two hypothesis can explain this result : a) the time-mineralization for the deposition of the all travertine used to be really short, less than 1 000 years or b) each sample analysis represent an averaged secular variation. Next step is to calibrate these data with an absolute radiogenic dating (U/Th) so as to determine between the two hypothesis.
We conclude that a chronology of leaking episodic events and sealing processes along active faults can be proved and measured : these data put forward different mechanisms of fluid flow trough the two faults which at first seamed similar. The good use of paleomagnetic tools on surface records of theses cycles represent a great step in the understanding of fault activity and seismic cycle mechanisms.