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Toward the use of a new and fast maturity indicator in very low-grade metamorphic claystones from the NW Borneo wedge.

Charles Aubourg (1), Francois Sapin (2), Manuel Pubellier (3), Dominique Janots (3), Myriam Kars (1,3), Abelatif Lahfid (3), Jean Pierre ¨Pozzi (3), and Jean-Claude Ringenbach (2)
(1) LFCR. Pau University France., (2) TOTAL, (3) ENS. UMR 8538. Paris

Below 300°C, few geothermometers exist in routine and it is still desirable to have additional information about the peak burial temperature reached by sediments. Within this range of temperature, the most used geothermometers are based on the alteration of organic matter like the Rock-Eval (T<150°C), the reflectance of vitrinite (T<300°), or the Raman spectroscopy(T>200°C). Here, we show that the magnetic assemblage of claystones can be an additional indicator. For immature to mature claystones (burial T<150°C), Aubourg and Pozzi (EPSL, 2010) showed that a diagnostic magnetic assemblage is observed. For low grade metamorphic claystones (burial T>250°), Rochette et al. (1990) showed the appearance of pyrrhotite at the expense of magnetite.
Along a ∼150 km transect across the NW Borneo wedge, we have collected 35 fresh Cenozoic claystones. From the NW to SE, there is a metamorphic gradient from immature to mature claystones to low-grade metamorphic claystones (lower green schist grade). In the NW of the cross section, Rock-Eval data, (420°C<Tmax<460°C) and vitrinite data (Ro<1.1%) show that claystones are immature to early mature with respect to the oil window. In the SE of the cross section, there is a fast jump of maturity, with Ro>2% and paleotemperature derived from Raman stpectroscopy from 180°C to 260°C.
We have measured the low-temperature (<300K) magnetic properties of claystones in order to check the nature of the magnetic minerals. Where claystones are immature to mature (T<150°C), we observed for all samples the diagnostic pattern described by Aubourg & Pozzi (EPSL, 2010). Where claystones are overmature, we observed a consistent pattern, different from the immature to mature claystones. Interestingly, we never observed the signature of pyrrhotite, as this mineral may be diagnostic of T>250°C. The magnetic assemblage is then diagnostic of low grade burial <250°C which is in fair agreement with standard geothermometers.
This study shows that the magnetic assemblage can be complementary of standard geothermometers. Interestingly, this measure is fast (<2 h), and non-destructive.