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A NEW PROVENANCE TOOL FOR THE EXPLORATION OF UNCONVENTIONAL PLAYS: THE PROVENANCE AND MINERALOGY OF SILT

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ABSTRACT

Quantitative provenance models, which relate vertical and/or lateral compositional trends within basin fills to the tectonic evolution of a source terrain, to changes in sediment dispersal patterns, or to palaeoclimate fluctuations, are still in their infancy. Development and application of such models is the domain of quantitative provenance analysis (QPA); the quantitative assessment of the type, amount and rate of supply of detrital material from identifiable parent-rock assemblages to a basin fill. Despite the efforts of many, traditional heavy mineral separation and point-count methods have always been qualitative to semi-quantitative techniques, the success of which was tied to the occurrence of particularly diagnostic grains (e.g. Cr-spinel) and biased by counts from different operators.

Heavy mineral concentrations in sediments depends tectono-stratigraphic level of eroded rocks. However, density-sorting during erosion, transport, or deposition can result in concentrated heavy mineral assemblages, or in the segregation of minerals with small differences in density within grain-size fractions and sedimentary environments. Post depositional dissolution results in depleted heavy minerals assemblages. Most of the controlling factors on heavy mineral assemblages can actually be recognised by the use of indices that can only be obtained by specific separation techniques.

Heavy Mineral Concentration (HMC) index. In sandstones it is a key to estimate diagenetic dissolution. Transparent Heavy Mineral Concentration (tHMC) index: It allows to calculate contributions from single sediment source areas to total sediment budgets. Source Rock Density (SRD) index: It is a proxy of the average density of source rocks, and thus of their crustal level.

Automated Heavy mineral analysis utilises a combination of Raman Spectroscopy and image analysis to automatically analyse and identify a large amount of heavy minerals from a sample. The automatic methodology allows to grains down to 10µm, expanding the capabilities of heavy mineral analysis to include silt. Using Raman, it is also possible to differentiate different types of Zircon based on the U-Th content and degree of radiation damage, and also different types of Garnets based on their major element chemistry. This data is produced during automated analysis and therefore requires minimal extra processing to extract this additional information.