REVEALING THE UNSEEN: THE APPLICATION OF CONFOCAL LASER SCANNING MICROSCOPY ON MICROFOSSILS, BRAZILIAN EXAMPLES

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ABSTRACT: Confocal Laser Scanning Microscopy (CLSM) is a powerful methodology that can improve studies on different geoscience areas. Confocal means: conjugate focal planes (illumination and detection of the same focal point) in which the emitted fluorescent light passes through an aperture (pinhole) to reduce the out-of-focus light. In this technique, a laser beam sequentially scans the specimen point by point and then assembles the pixel information, slice by slice, into a digital three-dimensional image. As a result, it acquires a set of optical sections (slices) with high contrast and high resolution, which can be rotated and illuminated from different angles. These photomicrographs display important details for taxonomy, diagenesis and climate studies, which could not be detected using traditional microscopes. It is also possible to acquire the fluorescence spectra, which reveals the highest-intensity wavelength. This data is very useful for paleoenvironmental and paleoecological studies. An advantage of this microscopy method is the possibility to use it with conventional palynological and petrographical slices and thin sections without additional preparation. The present study shows images acquired with a ZEISS LSM 700 confocal system, with laser lines of 405 nm, 488 nm, 555 nm, and 639 nm; scan resolution of up to 2,048 x 2,048 pixels; 8 bits of data depth; 63x and 100x oil objectives; and main distance between the slices of 0.06 µm. Images were taken of organic and calcareous microfossils recovered from sedimentary deposits (Proterozoic to Quaternary) and from recent lacustrine unconsolidated sediments; as well as of recent organic beings from Brazilian marine environments. These images elucidated taxonomic doubts, supporting proposals of new palynomorphs species (such as pollen grains, spores, chlorophyll algae, prasinophytes, dinoflagellates, acritarchs, hydrozoans) and recent cnidarian species (marine and non-marine). They also support thermal maturation studies of organic matter. Based on the images acquired from carbonatic microfossils on thin sections, it was possible to determine morphologic features previously obliterated by diagenesis, improving taxonomic, paleoenvironmental and biostratigraphic interpretations based on microfacies. Regarding fossilized ostracods, it was possible to analyze the normal and marginal pore canals, used for a better taxonomic definition, and the diagenetic features, such as the degree of dissolution and recrystallization of the carapace. The images from petroleum bearing fluid inclusions hosted in healed quartz microfractures and feldspar overgrowths of detrital grains have opened a new horizon for this area. It allows the tridimensional visualization of fluid inclusion shapes and the assemblage distribution. Volume estimation of the trapped oil/gas based on this data is performed in order establish PVTx-models used to reconstruct the earlier reservoir filling history. The application of the confocal method on different approaches, such as reworking or source rock research, is promising and reveals the potential for even more studies in a wide range of specimens/materials for the oil and gas industry.
KEYWORDS: PALEOMETRY, FOSSIL, DIAGENESIS.