

COMPUTERIZED NEUTRON TOMOGRAPHY FOR CORE ANALYSIS

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ABSTRACT

The imaging of core samples using both x-ray computerized tomography (CT) and nuclear magnetic resonance (NMR) have shown the usefulness of imaging techniques as ways of measuring the porosity of saturated cores by producing images of the hydrogen content. In this paper, we describe a method for tomographic imaging using thermal neutrons which has the advantage of imaging directly the hydrogen content of samples with high sensitivity. We have made three dimensional images of a brine-saturated sample of San Andres dolomite using thermal neutrons from the MIT research reactor. The interaction of thermal neutrons varies greatly from element to element but the interaction probability is particularly large for hydrogen. As an example, the absorption length for SiO_2 is approximately 0.3 cm^{-1} while water is approximately 3.4 cm^{-1} . This is in marked contrast to x-ray CT where materials of high atomic number dominate the absorption. The mineral matrix is essentially transparent to the neutrons and thus neutron CT images provide a direct way to image the water or hydrocarbon content of cores and hence to obtain porosity information. The neutron absorption of typical steel core holders is also relatively small, and it is possible to image cores while they are inside steel core barrels.