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Porosity Prediction in Quartzose Sandstones by Diagenetic Modeling: Application to Petroleum Exploration in the Area of Urica-Mundo Nuevo, Venezuela

Porosity evolution in sandstones is the result of physical and chemical processes acting through geological time. Properties controlling sandstone porosity include detrital mineralogy, texture, temperature and burial histories. The prediction of maximum porosity in sandstones at various depths and temperatures in unexplored areas can be possible considering that in sandstones, consolidation occurs by two processes: physical compactation and cementation, both processes accelerated by high temperatures, moving water solutions, and large pressures. Age, depth, temperature and petrographic data were modeled using Touchstone®, a diagenetic modeling software, for Oligocene and Miocene sandstones which are considered potential reservoir rocks in the area. The tendency of modeled porosities for all the samples shows an exponencial reduction of 16% at depths over 4500 m. In areas with relatively high temperatures, about 150ºC, sandstone porosities decrease to values lower than 14%. Similar sandstones in areas with a lower geothermal gradients (equivalent to colder temperatures) have average porosities of 22%. In general the porosity–age curves show that younger sands have higher porosities at equivalent depths. Likewise, higher temperatures in younger rocks may reverse this relation. This is the case of Miocene sandstones. These modeled sandstones suggest that areas of high thermal gradient are generally less favorable to the preservation of porosity with depth due to the solubility of quartz at higher temperatures. The observed curves provide a basis for estimating maximum expected porosities of untested sandstones in areas where geologic age and thermal gradient can be approximated.