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Physical properties evolution under thermal stress on pre-salt marbles from Campos Basin (Brasil)

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Carbonatic reservoirs in high temperature gradient zones can be subjected to several episodes of heat. This changes dramatically the texture and composition of the rocks by forming thermometamorphosed rocks such as skarns and marbles. This is particularly important for large oilfields found in pre-salt rocks, such as the Campos Basin (Rio de Janeiro state, Brasil) where the main formation (Macabu formation) is composed of silicified carbonates formed by the reaction of hot igneous intrusions due to the intracontinental rift associated with extensive intracratonic tholeiitic volcanism along the continental margin with intense normal faulting that has exposed carbonatic rocks to multiple episodes of heat. As a result we have a mineralogically complex and very diverse mixture of calci-silicate minerals. In order to analyse the influence of the thermal stress on the physical properties and failure mode of these rocks we investigated the Italva marble, a metasedimentary rock which contains two members, a calcitic and dolomitic marble with medium to coarse granulometry.

A number of physical properties such as density, porosity, P wave velocities and electrical resistivity measurements have been measured. Selected samples have been thermally treated at incremental temperatures of 200°C, 400°C, 600°C and 800°C. Initial porosity shows very low values for both lithologies (less than 0.5%) with values of physical properties typical of low porosity rocks. Upon thermal treatment a slight increase of porosity is observed which is mirrored by a decrease of the P wave velocities and electrical conductivity in wet conditions, which become more marked above 600°C, suggesting the formation of microcracks due to thermal stress which affect the physical properties and potentially the transport properties. These preliminary results open up to the need of the investigation of combined effects of thermal and mechanical stresses to assess the evolution of physical properties of pre-salt carbonatic rocks with application to oil reservoirs needs.