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Detailed petrophysical and geophysical characterization of core samples from the potential caprock-reservoir system in the Sulcis Coal Basin (South-Western Sardinia - Italy).

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The evaluation of the CO_2 geologic storage site requires a robust experimental database especially with respect to spatial petrophysical heterogeneities. The integrated analysis of minero-petrographical, physical and geophysical parameters (e.g. longitudinal and transversal propagation velocity, VpVs ratio, dynamic elastic moduli, etc.) of the rocks that make up a caprock-reservoir system can substantially reduce the geologic uncertainity in the storage site characterization and in the geological and numerical modelling for the evaluation of the CO_2 storage capacity. In this study the Middle Eocene – Lower Oligocene Cixerri Formation made up of siliciclastic rocks and the Upper Thanetian - Lower Ypresian Miliolitico Carbonate Complex in the Sulcis coal basin (South-Western Sardinia - Italy) have been identified respectively as potential caprock and reservoir for the CO_2 storage. The petrographical, physical and geophysical parameters of the above mentioned geological Formations (Cixerri and Milolitico) were investigated to improve the geological model aimed at verifying the geological CO_2 storage capacity within the carbonate reservoir rocks, in order to guarantee an efficient use of the reservoir, and to improve the numerical simulation of CO_2 behaviour in the short, medium and long term after its injection in single or multiple wells.
. The petrographical characteristics of the caprock-reservoir rocks were determined by optical and SEM analyses of core samples representing the different facies of the Cixerri Formation and of the Miliolitico Carbonate Complex, provided by Carbosulcis S.p.A.. Porosity analysis was completed by mercury porosimeter determinations which also provided quantitative information on the permeability of the study rocks and on the tortuosity of their pore system. Further physical properties, such as dry and saturated density and porosity, and water absorption were determined on the cylindrical core samples of intact rocks (ISRM, 1979) from wells drilled in the northern part of the Sulcis Coal Basin (Nuraxi Figus area). The propagation velocity of longitudinal (Vp) and transversal (Vs) waves was also determined on the same samples by a portable ultrasonic non-destructive digital indicating tester (P.U.N.D.I.T. plus) (ISRM, 1978). Starting from the P and S wave velocity, the dynamic elastic moduli (Young modulus, bulk modulus and Poisson's ratio) were determined using the well-known relationship involving the longitudinal (Vp) and shear wave (Vs) velocity and the rock bulk density. The elastic properties (Vp, Vs, elastic moduli) have been correlated with physical properties such as porosity and bulk density. The analysis of the above mentioned relations reveals that the geological formations that make up the caprock-reservoir system are affected by a high spatial heterogeneity in their petrophysical properties and then in their intrinsic characteristics. The petrophysical and geophysical parameter analysis also allowed to identify different lithologic types for the caprock (e.g. litharenites, siltites) and the reservoir (e.g. limestones, dolomitic limestones, calcareous dolomites). These data enhanced the interpretation of the surface reflection seismic data on the same area helping in distinguishing separate features.

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