

Linking an outcrop analogue to a deep potential CO₂ storage site with 3D geological model: an example from southwestern Sicily

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The southern Sicilian sector is notoriously rich in geological traps explored since '70 by oil and gas companies. Taking also into account the presence of numerous industrial emitters in the near Gela, this area is configured as potentially suitable for CCS (Carbon Capture and Storage) projects. In the area near Sciacca thick carbonate successions outcrop and it is characterized by a sequence of shallow water limestone covered by condensed pelagic limestones, all Jurassic in time. Seismostratigraphic, structural and sedimentological analysis carried out in the Sciacca area through 2D seismic reflection profiles and borehole data collected from public databases, confirmed the presence of potential reservoir and seal for CO₂ storage in correspondence of the Jurassic carbonates. The reservoir is represented by the Lower Jurassic peritidal limestones belonging to the Inici Formation consisting of grainstone-packstone with bivalves and benthic foraminifera with primary porosity. Analysis of facies and terrain analogs identified also a high secondary porosity in the upper part of the Inici Formation due to the fracturing, dolomitization, and paleokarstic processes. The seal is, instead, represented by the Middle-Upper Jurassic condensed pelagic deposits referable to the Buccheri Fm. known as Rosso Ammonitico. These condensed pelagic deposits consist of mudstone-wackestone with ammonites showing low porosity, due to the fine grain texture. The new collected data confirmed that in the area the outermost deformed portion of the western Sicilian chain outcrops composed of a double verging compressional structure delimited by NNE-SSW-trending left-lateral transpressive faults. In the offshore sector the seismic profiles interpretation highlighted the presence of a NE-SW-oriented ramp-anticline, bounded by high-angle deformation with transpressive kinematics. By combining seismostratigraphic and structural results with those derived from geological survey and samples analysis, we generated a 3D geological model defining thickness, lateral extension and fault boundaries (with their leakage potential) for reservoir and seal. This interpretation of the regional structure suggests a potential structural traps within buried antiformal stacks. This study, therefore, presents new data at the regional scale regarding the presence of reservoirs and seals (both onshore and offshore) potentially suitable for CCS purposes. By retrieving the parameters defined by the European Geocapacity Project, the CO₂ storage suitability for the area investigated has been estimated.