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Development of an Italian catalogue of potential CO_2storage sites: an approach from deep wells data

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Stabilize and reduce the atmospheric concentration of anthropogenic greenhouse gases is one of the principal goal that have to be accomplished in short time, in order to reduce the climate changes and the global warming, following the World Energy Outlook 2007 program by IEA. The most promising remedy, proposed for large CO_2 sources like thermoelectric power plants, refineries and cement industries, is to separate the flue gas capturing the CO_2 and to store it into deep sub-surface geological reservoirs, such as deep saline aquifers, depleted oil and gas fields and unminable coal beds. Among these options, deep saline aquifers are considered the reservoirs with the larger storage potentiality, as a consequence of a wide availability with respect to deep coal seems, depleted oil fields and gas reservoirs. The identification of a possible storage site necessarily passes through the demonstration that CO_2 can be injected in extremely safe conditions into geological deep formations, with impermeable caprock above the aquifer/s, which physic-chemical-mineralogical conditions are useful to a better mineral and solubility trapping as well as the hydrodynamic or physical/structural ones. In order to support the identification of potential storage reservoirs in Italy, INGV jointly with CESI RICERCA S.p.A. accomplished a detailed reworking of available geological, geophysical, geochemical and seismological data, in order to support the existing European GESTCO as well as the CO_2GeoCapacity projects.

Aim of this work is to establish some site selection criteria to demonstrate the pos-

sibility of the geological storage of CO_2 in Italy, even if it is located in an active geodynamical domain. This research started from the study of 7575 wells drilled on Italian territory during the last 50 years for gas/oil and geothermal exploration. Among this data-set as a whole, only 1700 wells (deeper than 800 m) have been selected. Only 1290 of these wells have a public-available composite log and fit with the basic prerequisites for CO_2 storage potential, mostly as deep saline aquifer/s presence. Wells data have been organized into a geodatabase containing information about the nature and the thickness of geological formations, the presence of fresh, saline or brackish water, brine, gas and oil, the underground temperature, the permeability, porosity and geochemical characteristics of the caprock and the reservoirs lithologies. Available maps, seismic and geological profiles containing or closer to the analyzed wells have been catalogued too. In order to constrain the supercritical behaviour of the CO_2 and to prevent the escape of gaseous CO_2 to the surface, a first evaluation of the caprock presence and quality has been done on these selected wells. Using a numerical parameterization of the caprock lithologies, a "*Caprock Quality Factor"* (Fbp) has been defined, which clustered the wells into 5 different classes of caprock impermeability (ranging between the lowest 1 to highest 5). The analysis shows that more than 50% of the selected wells have an Fbp Factor between 4 and 5 (good and optimal quality of caprock), and are mostly located in foredeep basins of the Alps-Apenninic Chain. The geodatabase also includes: $i)$ the seismogenetic sources (INGV DISS 3.0.4 *Database of Individual Seismogenetic Sources*), *ii)* an elaboration of seismic events catalogues (INGV CFTI, CPTI04, NT4.1), *iii)* the Diffuse Degassing Structures (DDS), as part of the INGV project V5 diffuse degassing in Italy geodatabase, considered as "CO_2 analogue" field-tests, *iv)* the distribution of the thermal anomalies on the Italian Territory, linked to the presence of volcanic CO_2 emissions, in order to consider the CO_2 diffuse degassing risk assessment on the Italian territory

Successively it has been created a geodatabase on the nature and quality of deep aquifers for the high-ranking wells sub-dataset (where the aquifers data are available), containing the following parameters: $i)$ presence of one or more aquifers deeper than 800 meters; *ii)* thickness of the aquifer/s; *iii)* lithology of the reservoir/s; i$v)$ available chemical analysis; $v)$ distance from closer power plants or other anthropogenic CO_2 sources.The final aim of these work is to help to find potential areas in Italy where CO_2 storage feasibility studies can be done. In these cases it is necessary to implement the knowledge by: $i)$ better evaluation of saline aquifer quality; *ii)* estimation of CO_2 storage capacity by 3D-modeling of deep crustal structures; *iii)* fluid-dynamic and geochemical modelling of water-rock-CO_2 interaction paths.