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Measurement of the $scCO_2$ storage ratio for the CO_2 reservoir rocks in Korea

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Abstract

Based on the lab experiments, the average $scCO_2$ storage ratio of the Janggi conglomerate was calculated at 31.2 %, which can be used to evaluate the feasibility of the Janggi basin as a $scCO_2$ storage site in Korea. Assuming that the average radius of the CO_2 storage formations is 250 m and the average thickness of the formations under 800 m in depth is 50 m, the $scCO_2$ storage capacity of the Janggi basin is larger than 400,000 tons, demonstrating that the Janggi basin has a great potential for use as a pilot scale test site for the CO_2 storage.

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Keywords: CO_2 sequestration; CO_2 storage capacity; CO_2 storage ratio; Janggi basin; the $scCO_2$ reservoir

1. Introduction

South Korea is ranked 6th among the OECD countries for greenhouse gas emissions, with a total of 6 billion tons of greenhouse gases emitted annually, as a result, South Korea's participation in compulsory CO_2 reduction is inevitable in the post-Kyoto Protocol world [1]. Therefore, the CO_2 sequestration in Korea should proceed so as to reduce emission of CO_2 and concentration of CO_2 in the atmosphere. Among the various geological sequestration methods, the aquifer sequestration and carbonate mineralization methods are considered to be most suitable for Korea because domestic onshore oil and gas fields or halite layers are rarely present. Currently in Korea, several studies have

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progressed in the selection of the CO_2 storage sites. Aquifer sequestration technology is one of the most efficient ways decreasing CO_2, and several domestic onshore sedimentary basins in Korea have potential as CO_2 sequestration sites. Among them, the Janggi basin is currently being evaluated as the most optimal CO_2 storage site in Korea [2, 3, 4].

The $scCO_2$ storage ratio (%) for a CO_2 reservoir is one of the most important factors in estimating the CO_2 storage capacity for geological formations and thus for selecting an optimal CO_2 storage site [5, 6]. The $scCO_2$ storage ratio is the fraction of the $scCO_2$ amount occupying pore spaces after the $scCO_2$ injection, and it can be calculated from the amount of $scCO_2$ that has been introduced into the pore spaces of the storage rock, replacing water [5]. From the $scCO_2$ storage ratio, the CO_2 storage capacity for the specific formation can also be calculated by volume of the stratum, average porosity and density of the $scCO_2$ [7, 8, 9]. The $scCO_2$ storage ratio and the CO_2 storage capacity for the reservoir rock in Korea have never been measured even in a laboratory. This study presents a quantitative investigation of the $scCO_2$ storage ratio under the CO_2 sequestration conditions to find out a successful subsurface CO_2 sequestration site in Korea. Laboratory experiments were performed to measure the amount of the $scCO_2$ replacing water in the pore spaces of the Janggi sandstones and conglomerates, which are classified as available CO_2 storage rocks in Korea. The feasibility of the Janggi sandstones and conglomerates as CO_2 storage strata in Korea was also evaluated according to the $scCO_2$ storage ratio measured in the experiments.

2. Experimental methods

2.1. Preparation of the conglomerate and sandstone cores

The Janggi basin is a Miocene sedimentary basin in southeastern Korea, an area which consists of small blocks such as the Guryongpo, Ocheon, Noeseongsan and Youngamri basins. Among them, the Noeseongsan and Youngamri blocks are available as CO_2 geological storage sites [2]. In particular, the Noeseongsan block is considered the most promising storage formation because it is deeper than the Youngamri block (it is possible to store CO_2 at below 800 m in depth) and also has stable cap rocks. In 2015, four sites in the Janggi basin were drilled by KIGAM (Korea Institute of Geoscience and Mineral Resources), and continuous drill cores to 1,200 m in depth were collected at each site. Fig. 1 shows a geological map around the two drilling sites (JG-1 and JG-4) and their well logging data.

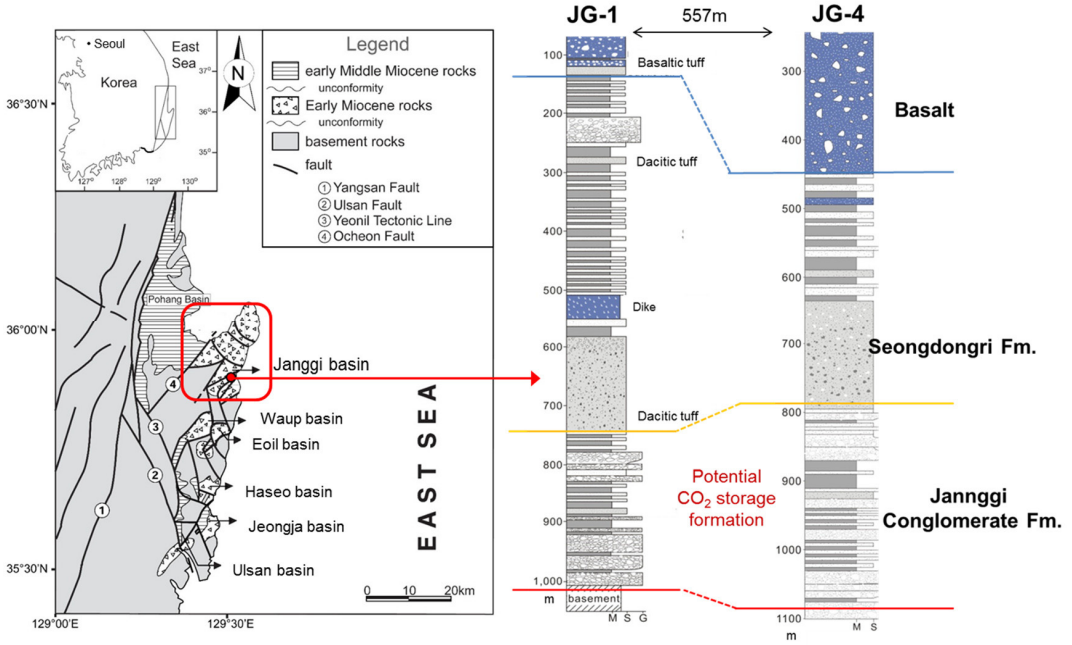

Fig. 1. The geological map around the drilling well locations (●) and well logging data for the rock cores used in the experiments.