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A General Method for Calculating Subsurface CO_2 Storage Capacity

L.G.H. (Bert) van der Meer, SPE, and P.J.P. (Paul) Egberts,TNO Built Environment and Geosciences, Princetonlaan 6, 3508 TA Utrecht, the Netherlands

Abstract

It is neither straightforward nor simple to estimate the capacity of a geological formation to store CO_2. In a recent attempt to list the various estimates of CO_2 storage capacity for the world and regions of the world (Bradshaw et al., 2006), the estimates are often merely given as “very large”, with ranges in the order of 100s to 10,000s Gt CO_2. It is clear that there is a general lack of definitions, rules and general procedures for calculating storage potentials.

Having conducted studies in the past, TNO is convinced that we now need a more uniform and standard method to calculate the storage potential of any subsurface location – be it a gas or oil field (whether totally or partially depleted) or an aquifer. In any calculation of storage capacity, TNO prefers to include the concept of total affected space i.e. the entire space whose state or qualities change during the total storage time as a result of the storage operation. Furthermore, in the storage calculations we consider the injectivity of the selected injection location, and the pressure and fluid conductivity of the total affected storage space.. The intended free CO_2 storage location must have enough storage space or enough sealing capacity to contain the CO_2 for at least 10,000 years and prevent it from migrating to the surface. And finally, it must be taken into account that as a result of gravity segregation, the heavier CO_2-saturated formation water will sink to deeper parts of the affected space.

We describe a standard method we have devised to be used for any storage location to calculate the maximum storage volume based on affected space and maximum pressurization, the storage potential based on injectivity, and finally the storage efficiency of the geological trap.

Keywords: CO_2, Storage capacity, trapping efficiency, CO_2 injectivity

Introduction

We often need to know how much CO_2 we can store in a certain underground space, or how much such space we need to store a given amount of CO_2. In a recent attempt (Bradshaw et al., 2006) to list various regional and global estimates of CO_2 storage capacity (figure 1), the estimates reported are often quoted as “very large” with ranges in the order of 100 to 10,000 Gt of CO_2. From the publications Bradshaw and his colleagues consulted it is clear that there is a lack of definitions, rules and general procedures for calculating storage potentials. The calculations of CO_2 storage capacity are mainly based either on the solubility potential (Bachu *et al*., 2003) and ignore volumetric consequences and the kinetics of this process, or on a fixed percentage of a subsurface volume (Koide *et al*., 1992). None of the cases using the latter approach include any definitions. In this paper we will specify a method to calculate the *Theoretical Maximum Storage Capacity*. We will give comprehensive definitions of all the important parameters in a separate and upcoming publication. In the present paper, the parameters appear in *italics*. They are briefly described below.