23 Modeling of Subsurface CO_2 Migration at Geological Carbon Sequestration Sites in Deep Saline Aquifers

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23.1 INTRODUCTION

The latest assessment report (Assessment Report 5 or AR5) from Working Group III (WGIII) of the Intergovernmental Panel on Climate Change (IPCC) observes that despite institutional, national, and international policies aimed at mitigating anthropogenic greenhouse gas (GHG) emissions, GHG emissions have actually grown at a rate of 2.2% per year during 2000–2010, which is faster than the rate (1.3% per year) over the entire period 1970–2000 (IPCC, 2014). The WGIII makes the additional observation that GHG emissions, approximately 76% of which are estimated to be carbon dioxide (CO_2), will continue to rise in the coming decades and will have significant impacts on global climate unless effective mitigation strategies are put in place. While no one mitigation strategy on its own is expected to stabilize or reduce GHG levels in the atmosphere, carbon capture and storage (CCS) has been identified as one of the viable technologies for accomplishing this objective (IPCC, 2005).

CCS is a physical process that involves capturing anthropogenic CO_2 from stationary sources (e.g., power plants) and storing it before its release to the atmosphere. An integrated CCS system, as summarized by Folger (2013), would include three main steps (see Figure 23.1): (1) capturing CO_2 and separating it from other gases; (2) purifying, compressing, and transporting the captured CO_2 to the sequestration site; and (3) injecting the CO_2 in subsurface geological formations, where it is expected to remain potentially trapped for hundreds, if not thousands, of years without any negative

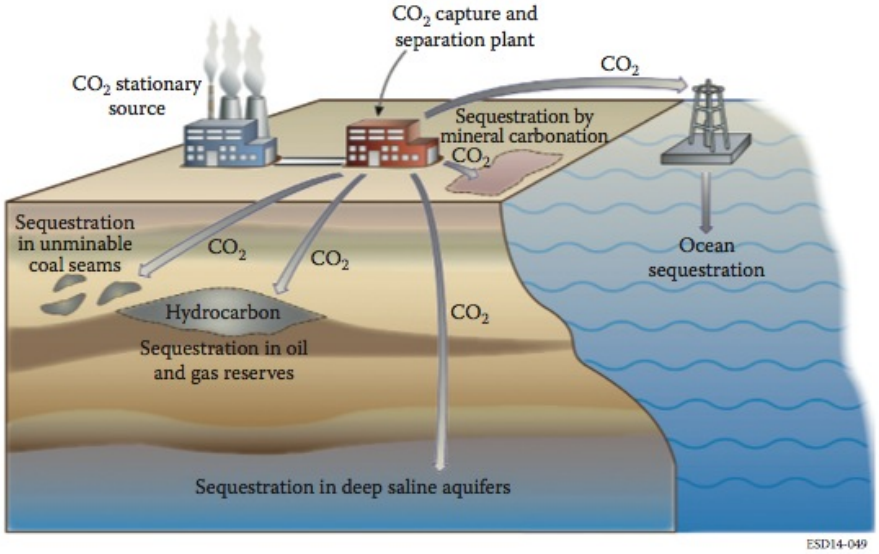

FIGURE 23.1 Schematic drawing illustrating the essential components of an integrated CCS, and available sequestration options, which include sequestration by mineral carbonation, ocean sequestration, and sequestration in unminable coal seams, oil and gas reserves, and DSA. The focus of this chapter is modeling CO_2 migration in DSA.