

Phase relationships in the system Na₂CO₃-CaCO₃-MgF₂: Application to the crystallization of Oldoinyo Lengai natrocarbonatite

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The volcano Oldoinyo Lengai is the world's only active carbonatite volcano and until recently has been characterized by the eruption of natrocarbonatite lavas consisting principally of nyerereite (Na₂Ca(CO₃)₂), gregoryite [(Na,Ca)₂CO₃], halite-sylvite, fluorite and potassium neighborite (NaMgF₃). The pseudoternary system Na₂CO₃-CaCO₃-MgF₂ includes nyerereite (NY), gregoryite (NC) and neighborite (Pv). Phase relationships along 5 joins in the subsystem NC-NY-MgF₂ have been determined at 0.1 GPa at diverse temperatures to establish liquidus phases and in some instances subsolidus assemblages. Knowledge of the latter is useful in predicting the mineralogy of rocks formed by the crystallization of natrocarbonatite under hypabyssal conditions within the volcano.

Primary liquidus phases encountered in NC-NY-MgF₂ include gregoryite, nyerereite, calcite and neighborite. Along the join NC-MgF₂ there is a eutectic at 600°C and 20 wt.% NC. The subsolidus assemblage is NC+Pv+eitelite [Na₂Mg(CO₃)₂]. This eutectic extends into the ternary system as a cotectic leading to a pseudoternary eutectic at the approximate composition of NC₅₀CC₂₃(MgF₂)₂₇ involving NC, Pv and NY at about 575°C. Phase relations along the join NY-MgF₂ are characterized by the crystallization of calcite for compositions with > 10 wt.% MgF₂ and Pv at approx 45 wt.% MgF₂. Calcite and Pv are in reaction relationship with NY at a reaction point at ~ 600°C. Subsidiary assemblages consist of NY+Pv+dolomite+eitelite. Phase relations on other joins indicate that initial crystallization of NC is followed by NY along a cotectic that terminates at the Pv+NC+NY pseudoternary eutectic. Our data show that gregoryite will crystallise before nyerereite in natrocarbonatite magmas and that differentiation leads to Mg enrichment and the formation of fluoroperovskites. Crystallization under hypabyssal conditions could result in dolomite and eitelite-bearing assemblages.

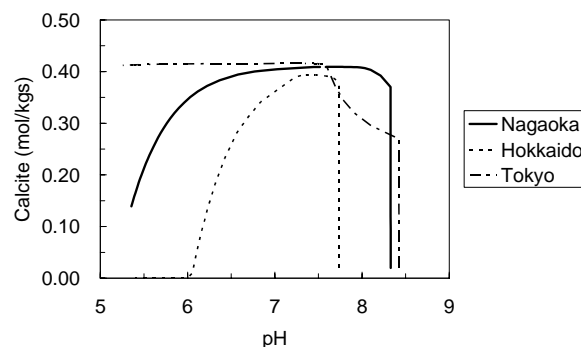
Influence of formation water composition on mineral trapping of CO₂

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The one of bridge technologies to support moving into a low carbon world is CO₂ Capture and Storage (CCS). To use sub-surface space effectively, CO₂ is injected in a deep saline aquifer such as satisfying the conditions of temperature and pressure as supercritical phase. A part of CO₂ dissolves into the formation water and then it is fixed as carbonate minerals (mineral trapping). At the mineral trapping stage CO₂ can't migrate by its buoyancy and/or fluid flow thus mineral trapping is considered as the most secure mechanism of isolation of CO₂ from the atmosphere [1].

In Japan, pilot-scale CO₂ injection test was conducted at Nagaoka site. The results of the formation water sampling showed that the low salinity water have high potential of the mineral trapping of CO₂ [2]. The aim of this paper is to discuss influence of formation water composition on mineral trapping of CO₂. Three typical compositions of formation water in the Japanese marine sediments were chosen to estimate potential of carbonate mineral precipitations by PhreeqC [3]. The water compositions affected the pH ranges on the carbonate precipitation. This result was considered to be caused by difference of Ca concentration and alkalinity.



[1] Gunter *et al.* (2004) In: *Baines and Worden, editors. Geological storage of carbon dioxide*, Geological Society, **233**, 129-145. [2] Mito *et al.* (2008) *IJGGC*, **2**, 309-318. [3] Parkhurst & Appelo (1999) *U.S. Geological Survey Water-Resources Investigations Report*, **99**, 312 pp.