Carnegie Mellon University

Carnegie Institute of Technology

THESIS

Submitted in partial fulfillment of the requirements
for the degree of **Doctor of Philosophy**

Measurement and Recovery of Rare Earth Elements from Hypersaline Fluids

Clinton W. Noack

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Measurement and Recovery of Rare Earth Elements from Hypersaline Fluids

Submitted in partial fulfillment of the requirements for

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Doctor of Philosophy

in

Civil & Environmental Engineering

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Chapter 1

Introduction, problem identification, and research goals

1.1 Introduction

1.2 Problem identification

1.3 Research goals

Chapter 2

Rare earth element distributions and trends in natural waters with a focus on groundwater

This chapter is adapted from a publication by the same name, co-authored by David A. Dzombak and Athanasios K. Karamalidis. This paper is citable as:

Noack, C. W.; Dzombak, D. A.; Karamalidis, A. K., Rare Earth Element Distributions and Trends in Natural Waters with a Focus on Groundwater. *Environ. Sci. Technol.* **2014**, *48*, (8), 4317-4326.

Abstract

blah blah blah

2.1 Introduction

blah blah

Chapter 3

Rare earth element distributions and trends in natural waters with a focus on groundwater

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Noack, C. W.; Dzombak, D. A.; Karamalidis, A. K., Determination of Rare Earth Elements in Hypersaline Solutions Using Low-Volume, Liquid-Liquid Extraction. *Environ. Sci. Technol.* **2015**, *Article ASAP*, DOI: 10.1021/acs.est.5b00151

Abstract

blah blah blah

3.1 Introduction

blah blah