Weathering of pyroxenes

J. Chischi[1], *H. C. Oskierski*[2], *G. Senanayake*[3], *M. Altarawneh*[4], *M. F. Alhadad*[5], *B. Z. Dlugogorski*[6]

1.
PhD student, Murdoch University, Perth Western Australia 6150.
Email: Johannes.Chischi@murdoch.edu.au

2.
Lecturer at Murdoch University (Supervisor), Murdoch University, Perth Western Australia 6150.
Email: H.Oskierski@murdoch.edu.au

3.
Associate Professor at Murdoch University (Supervisor), Murdoch University, Perth Western Australia 6150. Email: G.Senanayake@murdoch.edu.au

4.
Lecturer at Murdoch University (Supervisor), Murdoch University, Perth Western Australia 6150.
Email: M.Altarawneh@murdoch.edu.au

5.
PhD student, Murdoch University, Perth Western Australia 6150.
Email: Mahmoud.Alhadad@murdoch.edu.au

6.
Professor at Murdoch University (Supervisor), Murdoch University, Perth Western Australia 6150.
Email: B.Dlugogorski@murdoch.edu.au

ABSTRACT

Pyroxene group minerals play a crucial role in the minerals industry, especially Li-bearing spodumene. Thus, understanding the chemical weathering of these minerals can give further insight into the dissolution behaviour of spodumene under different conditions. In this presentation, we will review the recent literature on dissolution of pyroxene minerals. In particular, we will focus on weathering of spodumene samples from Greenbushes in Western Australia in field studies (Singh & Gilkes 1993) or in laboratory investigations involving experimental reactors for weathering of augite, diopside or enstatite (Daval et al. 2013). The latter studies comprise measurement of weathering rates as a function of time at different temperatures and pH, with the analysis involving several electron beam techniques.

The most significant findings cover the dissolution rates, the formation of amorphous silicate layers (ASSL) along with surface passivation and etch pits. Mineral faces govern the magnitude of all these features observed in the experiments (Daval et al. 2013). For example, experimental dissolution rate for silica (-log R_{Si}) in diopside ranges between -13.3 and -16.4 due to different pH conditions of 4.8 and 6.0 (Wilson 2004). Furthermore, the so-called topotactic mechanism affects the weathering of most pyroxenes, leading to a chemical change of the weathering mineral, but conserving one or more crystallographic properties of the original material (Günter & Oswald 1975). However, weathering of spodumene leads to a complete breakdown of its structure involving the formation of smectite, a clay mineral, and the loss of most of its Li (Singh & Gilkes 1993).

This presentation shows that both the dissolution rate as well as the surface passivation by ASSL play a significant role during pyroxene weathering and should be considered during industrial processing.

Keywords: Pyroxene group minerals, weathering, dissolution, amorphous silicate layers

Literature

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