American Mineralogist, Volume 84, pages 493–505, 1999

Dynamic electrochemical assessment of redox reactions in natural micas between 613 and 1373 K at 10^5 Pa

Dorothee J.M. Burkhard,[1,*] Gene C. Ulmer,[2] Günther Redhammer,[3†] and George H. Myer[2]

[1]University of Marburg, Scientific Center for Materials Research and Institute for Mineralogy, 35032 Marburg, Germany
[2]Temple University, Department of Geology, Philadelphia, Pennsylvania 19122, U.S.A.
[3]University of Salzburg, Institute for Mineralogy, 8020 Salzburg, Austria

Abstract

ZrO_2-EMF measurements were carried out on natural biotite samples between about 400 and 1100 °C in a closed system in a pure argon atmosphere (99.9999%). The EMF patterns are complex and cannot be compared to classical equilibrium $1/T$-log f_{O_2} data. Instead, the electrochemical method, when applied to hydrous phases, is a non-equilibrium, dynamic technique, comparable to differential thermal analyses. The data are interpreted from the perspective of atomic processes that control EMF readings and in light of mica-breakdown reactions known from the literature. These breakdown reactions occur at mainly three temperatures marking the onset of dehydroxylation, of oxidation, and of breakdown to oxides. The new application of ZrO_2-EMF measurements proposed herein demonstrates the advantage of dynamic tracking of mica breakdown reactions; so that in a single experiment, all breakdown reactions may be studied sequentially for a specific mineral sample.