

BOOK REVIEW

Micro- and Mesoporous Mineral Phases

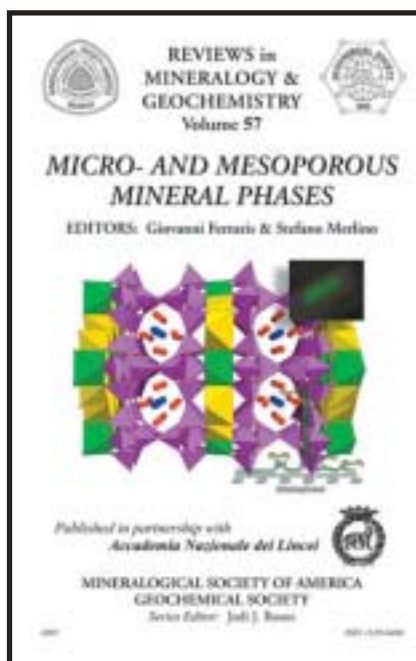
Reviews in Mineralogy and Geochemistry, Volume 57

Giovanni Ferraris and Stefano Merlino, editors

Most geoscientists probably use the term *zeolites* as a synonym for micro- and mesoporous mineral phases. Why then has a new volume with just this title been published only four years after Vol. 45 "Natural Zeolites: Occurrence, Properties, Applications" appeared in the same review series RIMG?

A *zeolite* mineral is, according to the commission of the International [Coombs et al., (1997) *Canad. crystalline substance with a dimensional framework of linked contains open channels and cages occupied by H₂O molecules and (guests). Within the last two considered materials with hosts other than tetrahedra (triangles, micro- and mesoporous materials. present Vol. 57 is much wider than were not treated in the present 2001 is still up to date.*

Although geoscientists are crystalline substances with contain non-tetrahedral building micro- and mesoporous materials, minerals is responsible for many of their geochemical and mineralogical properties. Therefore, the present review is very timely and should serve to make geoscientists aware of the important properties of such poroate minerals.



definition recommended by a Mineralogical Association (IMA) Mineral. 35, 1571-1606], a structure characterised by a 3-[TO₄] tetrahedra (the *host*) that (*pores*), which are usually extra-framework cations decades, some researchers have built from linked polyhedra pyramids, octahedra etc.) to be Consequently, the scope of the that of Vol. 45. In fact, zeolites volume because their review of

unaccustomed to regard inorganic host frameworks that units (so-called poroates) as the porous character of such

In agreement with the recent recommendation of the International Union of Pure and Applied Chemistry (IUPAC) [McCusker et al., (2003) *Micropor. Mesopor. Mater.* 58, 3-13], the present Vol. 57 treats all kinds of poroates, independent of the building units of their inorganic host frameworks and of the dimensionality of their hosts and their pores. Because the properties of poroates depend not only on the structure, but also on the chemical composition of their hosts, the materials covered range from oxides to sulfides and selenides, from silicates to phosphates and uranates, etc. Of the vast number of poroates covered in this volume, the majority are natural minerals but, laudably, related synthetic phases are also discussed. Altogether a wealth of information is given.

The first chapter by L.B. McCusker describes the IUPAC nomenclature and its application to non-zeolite microporous mineral phases, and Chapter 2 by S. Krivovichev deals with the general topology of microporous structures. In Chapter 3, G. Ferraris and A. Gula discuss several families of layer silicates such as the sepiolite - palygorskite family, the astrophyllite group and the bafertisite group as polysomatic

series. In Chapters 4 and 5, N.V. Chukanov and I.V. Pekov present detailed information on the structure, genesis and properties of so-called heterosilicates, i.e., silicates in which silicate anions are complemented by penta-coordinated or octahedrally coordinated transition element cations to form mixed frameworks, which are often microporous. Such minerals are typically formed in postmagmatic processes of peralkaline rocks such as the pegmatites, hydrothermalites and metasomatites from Ilmaussaq, Mount-Saint Hilaire and Lovozero. They can be used as index minerals in the geochemistry of the rare and transition elements and as indicators for specific geological conditions. Other microporous mixed tetrahedral-pentahedral-octahedral framework silicates, their properties and application in catalysis, sorption and luminescence are treated by J. Rocha and Z. Lin in Chapter 6.

Sodalite and the minerals of the cancrinite - davyne group contain cage-like pores but no channels. They were, therefore, not treated in the zeolite volume but are discussed in Chapters 7 and 8 of the present volume, which are written by W. Depmeier and E. Bonaccorsi & S. Merlino, respectively. The latter chapter contains, in addition, a description of the calcium silicate hydrates.

Chapter 9 by M. Pasero deals with tunnel structures. Their hosts are entirely built by linkage of octahedra that are usually centred by transition element cations. The presence of these cations in two different oxidation states requires charge balance by alkali- and alkaline-earth cations located in straight channels (the so-called tunnels). Although minerals of the apatite family are usually considered as dense phases with isolated $[\text{PO}_4]$, $[\text{AsO}_4]$, $[\text{SiO}_4]$, etc. tetrahedra, T. White, C. Ferraris, J. Kim and S. Madhavi describe them in Chapter 10 to have microporous host frameworks built from tetrahedra and octahedra, which are centred by Ca^{2+} , Sr^{2+} , Ba^{2+} , Pb^{2+} , etc. Channels within the framework also contain these cations and F, OH^- or O^{2-} anions.

In Chapter 11, E. Makovicky explains that a large number of sulfides and selenides of cations with a lone electron pair, such as As^{3+} , Sb^{3+} , Bi^{3+} , Pb^{2+} etc., have microporous hosts with channels occupied by cations and sometimes anions. The final chapter, written by M. Mellini, reports on microporous forms of carbon (anthracites, fullerenes and carbon nanotubes), serpentines and clathrate hydrates.

The volume is a comprehensive and richly illustrated review of micro- and mesoporous crystalline phases with inorganic host structures (poroates). It is well edited and produced. Geochemical aspects are particularly addressed in Chapters 4 and 5 and to a lesser extent in Chapters 8, 10 and 11. Their technical applications as ion exchangers, absorbers, catalysts, fuel-cell electrolytes, luminophores and for waste disposal are discussed in Chapters 4, 6, 8-10, and 12. The review is especially suited to widen the horizon of geochemists and mineralogists alike with respect to correlations between structure and properties of minerals.

The usefulness of this, as well as other volumes of RiMG, would be improved if at the end there would be an index of the minerals described. With present day computer programs this should not be a difficult task.

Friedrich Liebau
Institute of Geosciences
University of Kiel, Germany
liebau@min.uni-kiel.de