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Book review

Földvári, Mária: Handbook of the thermogravimetric system of minerals and its use in geological practice

Occasional Papers of the Geological Institute of Hungary, vol. 213, Budapest, 2011, 180 p.

This handbook contains an almost complete dataset of thermal properties of minerals. It can be considered as the summary of the author's life-long activity in the thermal laboratory of the Hungarian Institute of Geology. A similar but much less comprehensive book on the same subject was published by the author in 1986, in the series of methodological publications of the institute (MÁFI Módszertani Közlemények, vol. 9). The mother of the author, Mária Földváriné Vogl was a pioneer of the mineralogical application of thermal analysis. She published the first manual of the thermal method in mineralogy in 1958. The author herself is in many respects closely connected with the Department of Mineralogy and Geology of Debrecen University. Her father, professor Aladár Földvári (1906–1973) was one of the founders of this department. She obtained her PhD degree there on the subject of thermal analysis under Professor Gyula Szöőr. In addition, she participated in many common projects with members of the university.

The present handbook consists of two main parts. The first, shorter part discusses the methods applied. The second, main part contains the thermal curves and data of the actual minerals, listed in systematic order. This part is completed by a very rich bibliography comprising 1195 items and by an index of mineral and rock names occurring in the text.

In the methodological part the tools and instruments involved and the experimental procedures are only briefly mentioned. Some basic evaluation processes are discussed in more detail, such as

– the application of stoichiometric factors in quantitative analysis,
– the second derivate of the TG curves,
– the analysis of the gases formed during heating, including mass spectrometry thereof,
– the correction of the decomposition temperature according to the sample amount.

The various ways water is bonded in minerals is discussed in detail in the book, based on earlier studies of the author. Her results in this field were acknowledged with the Vendl Mária Memorial Medal of the Hungarian Geological Society in 1997.

She attempted to understand the theory behind the correlation between decomposition temperature and electronegativity of the cations, as well as the complexity of the structure.

The systematic part of the Handbook presents the thermo-analytical curves of 114 mineral types. All curves were selected from the author's own work in the laboratory, from a total of 35 thousand measurements. Most of these basic experimental data are today systematically arranged in a database of the laboratory. All experimental curves published in the handbook appear in a comparable, standardized way, accompanied by an explanation of the chemical reactions observed. For each reaction the stoichiometric factors are given. Examples of quantitative determination are shown using data taken from the actual curves employed.

The mineral groups and species are treated in a uniform, standardized way; however, one can find several interesting geologic applications and mineralogical conclusions in the descriptions. Some examples are given below:

Oxides. Among the silica minerals there are "wet" and "dry" opals depending on their water content.

Oxy-hydroxides. Ferrihydrite, a recently widely studied member of this group, is discussed in detail in the book. Several hydroxides of Al, Fe and Mn are related to bauxites and manganese ores which are typical Hungarian raw materials and special analytical methods were developed in Hungary for their study. The book includes the description of the quantitative analysis of bauxites and the determination of the Al content of alumo-goethites.

Silicates. Obviously the most extensive chapter of the book deals with the determination of phyllosilicates, including clay minerals.

Kaolinitic minerals. M. Földvári developed special methods to determine the degree of ordering and water content of the disordered varieties. She shows that genetic types of kaolinite may have different corrected decomposition temperatures.

Smectite group. A considerable body of information was accumulated as a result of earlier and current studies of bentonite deposits over the entire Carpathian Basin. Special compositional types were identified, such as Fe-rich beidellite in basalt bentonite and Fe-rich saponite (formerly called "mauritzite") found in basic and intermediate volcanic rocks. The book explains why the dehydroxilation of the so-called "abnormal" montmorillonite proceeds in two steps.

Mica clay minerals. The nomenclature and the chemical composition of the mica clay minerals used by the author are not completely in accordance with the recommendations of the IMA Nomenclature Committee (Rieder et al., 1998). However, the deviation is actually inherent in the nature of thermal analysis. Thermal analysis considers primarily the water content and the bonding energy of the OH groups. On the other hand, definitions of minerals in the recommendations are based on the layer charge and interlayer K contents. The nomenclature used in the Handbook can be justified in this particular case

because the correlation of these parameters with the water and OH content is not well known and depends on several other factors. There is a minor error in the classification of glauconite and celadonite which cannot be accepted: they are classified in the book as di-trioctahedral minerals (Table T5.1.2). The correct classification in this case is simply: dioctahedral.

Mixed-layer clay minerals. Generally structural details of this group cannot be determined by thermal analysis. It is still possible, however, to find interesting data in this monograph regarding a rare regularly mixed-layer phase, tosudite. This mineral is found at Sukoró, Velence Mts.

Zeolites. The book contains a wide range of data relating various zeolite minerals, all investigated by the author. Recently mineral associations of natrolite, gonnardite and phillipsite occurring in the vesicles of Transdanubian basalts were studied. Thanks to thermal methods the alteration products of rhyolite tuffs, mordenite, heulandite and clinoptilolite, can be well differentiated.

Carbonates. Among the most common carbonate minerals, disordered and non-stoichiometric varieties of calcite and dolomite can be identified by their thermal behavior. They occur mostly in young sediments and soils. In travertine the temperature of calcite formation can be related to the corrected decomposition temperature measured on the thermal curve. The author points out that special difficulties may arise during the quantitative determination of siderite. On the other hand, in Fe-rich mixed carbonates the proportion of the cations can be estimated by thermal methods (e.g. ankerite of "real composition", ferrous dolomite).

Sulfates. The atlas contains a high number of thermal curves of hydrous sulfate phases based almost exclusively on the author's own measurements of materials from Hungarian localities. These curves may be rather complex due to the gradual loss of the water content in several steps.

Special applications. Thermal analysis can be successfully applied to the study of natural raw materials that cannot be considered to be minerals. Examples are the degree of coalification of brown and black coal, the water content of perlite and the gas emission of natural glasses. The author emphasizes the importance of joint application of thermal and XRD methods for the accurate quantitative mineralogical analysis of rocks and raw materials.

The editors of the book, Olga Piros and Dezső Simonyi, have carried out their work very carefully, with a minimum number of errors left. The style is very concise, almost too sketchy. Obviously the author tried to compress a large amount of knowledge into the limited framework of the book. The English language is quite understandable, the language was reviewed by Richard McIntosh. There are only a few instances of erroneous application of rock names or other special terms. The Directorate of the Institute of Geology and the Hungarian Academy of Sciences can be congratulated for having recognized the importance of the subject and for supporting the publication of this work.

In summary, the book is the result of the devoted work of a permanently high standard of the author. Compared to similar manuals of thermal analysis published before, the present book seems to be the most comprehensive, most accurate and most clearly explained. In 2012 the Hungarian Geological Society awarded the author the Szabó József Memorial Medal, the highest award of the society, for this work.

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