

## BOOK REVIEW

**Thermodynamic Values at Low Temperature for Natural Inorganic Materials: An Uncritical Survey**, by Terri L. Woods and Robert M. Garrels, Oxford University Press, New York, 1987, 280 pp. (including unnumbered pages in References and Introduction), softbound, \$18.95 (ISBN 0-19-504888-1).

This book of tables is a handy and inexpensive softbound compilation of molar and molal standard state thermodynamic data at 25°C and 1 bar from different sources for solids, gases, and aqueous species. The enthalpy of formation, Gibbs free energy of formation, and the third law entropy are listed (when available) from different sources for each of these chemical constituents. As implied in the title, the data are presented without discussion as to the reliability, accuracy, or consistency of the values.

The text will be useful for students seeking a tabulation of data from different sources for computing equilibrium constants at 25°C and 1 bar. Researchers will want this text to use for easy comparison of data from the several different "critical" surveys of geochemical data, e.g., those of Helgeson *et al.* (1978, *Amer. J. Sci.* **278-A**, 229 pp.); Robie *et al.* (1978, *U.S. Geol. Surv. Bull.* **1452**, 456 pp.); and the National Bureau of Standards (NBS) tables.

A critical reader will find some minor problems with the text. The Table of Contents lists the page number for groups of constituents in which a particular element forms the first element in their formula. Within each group the constituents appear in consistent sequence. For convenience, the authors should have also provided a supplementary index in which the more than 1000 constituents in the tables are listed.

A more important problem is the omission of standard state data on heat capacities and volumes. These should be added in future editions. In addition, the authors should consider adding (if available) the heat-capacity power-function coefficients for solids and gases, as well as the coefficients for aqueous species for use in the Helgeson equation of state. These changes would allow the reader to make calculations at pressures and temperatures other than 1 bar and 25°C.

Only 121 sources are listed for the data in the tables. Older compilations of outdated data have been included, but these probably should have been omitted (although this is a sub-

jective evaluation), e.g., early NBS tables; Garrels and Christ (1965, *Solutions, Minerals and Equilibria*, Freeman, Cooper and Co., 450 pp.); Robie and Waldbaum (1968, *U.S. Geol. Surv. Bull.* **1259**, 256 pp.); and Helgeson (1969, *Amer. J. Sci.* **267**, 729-804).

In addition, references to many important experimental studies have been omitted and are not available from the sources listed in the tables by the authors. For example, for the *geochemically important*  $\text{H}_3\text{SiO}_4^-$  aqueous species, the listed sources are Garrels and Christ (1965, Freeman, Cooper and Co., 450 pp.); Naumov *et al.* (*Handbook of Thermodynamic Data*, 1974, *Natl. Tech. Inf. Service Publ.* **226**, 328 pp.) and Mel'nik (*Thermodynamic Constants for the Analysis of Conditions of Formation of Iron Ores*, 1972, Naukova Dumka, Kiev, 196 pp., in Russian). No references are given for data from the many studies in English which are based on the experimental determination of the dissociation constant of  $\text{H}_3\text{SiO}_4^-$ , as summarized in the review by Fleming and Crerar (1982, *Geothermics* **11**, 15-29). Another example involves calcite and aragonite in which the detailed review and study by Plummer and Busenberg (1982, *Geochim. Cosmochim. Acta* **46**, 1011-1040) has been omitted. In addition, the authors did not report any data from the large set of internally consistent values for minerals recently reported by Berman *et al.* (1985, *Atomic Energy of Canada Tech. Rept.* **337**, 62 pp.). The list goes on. The implication is that the reader may not have much success in using sources in the text as a starting point to evaluate the best data available for a particular constituent.

Having made these points, I recommend the book to all geochemists. The text contains an enormous amount of data, including thermodynamic parameters (of questionable reliability) on clays. Geochemists are data "junkies" by training. At the Annual Meeting of the Geological Society of America in San Antonio in 1986, advance copies of this book sold like hotcakes. The price is right, and the data compilation will be essential for students in undergraduate and graduate-level geochemistry courses. Researchers will use it to make preliminary calculations on thermodynamic problems.

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