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Note

Chemical analyses of meteorites at the Smithsonian Institution: An update

Eugene JAROSEWICH

Department of Mineral Sciences, Smithsonian Institution, Washington, D.C., 20560, USA
E-mail: jarosewi@si.edu

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Abstract–Thirteen new meteorites and three meteorite inclusions have been analyzed. Their results have been incorporated into earlier published data for a comprehensive reference to all analyzed meteorites at the Smithsonian Institution. The six tables facilitate a convenient overlook of meteorite data. Table 1 presents an alphabetical list of analyzed meteorites, Table 2 chemical analyses of stony meteorites, Table 3 chemical analyses of iron meteorites, Table 4 elemental composition of stony meteorites, Table 5 average composition of carbonaceous chondrites and achondrites (falls and finds), and Table 6 presents average composition of H, L, LL, and Antarctic chondrites (falls and finds). The tables are available online at the journal's Web site http://meteoritics.org.

Since the earlier publication of the chemical analyses of 277 meteorites and meteorite inclusions (Jarosewich 1990), an additional thirteen meteorites and three meteorite inclusions have been analyzed. Several of these fill compositional gaps in the earlier work, and their analyses broadens the meteorite database for studies relating meteorites to asteroids and planetary bodies.

Several of the newly analyzed meteorites expand the existing database of previously analyzed groups, including Axtell (CV3), Esperance (L3), Magombedze (H5), Chaunskij (MES, inclusion and metal), Sioux County (EUC, whole meteorite and basaltic inclusion) and Willard (H3). These meteorites have been previously studied and described in the literature, the references of which are given in Table 2. These studies dealt with descriptive aspects of meteorites and often included discussion on formation and origin of meteorites. Several of the new meteorites fill gaps in the earlier data. Burnwell is an ungrouped ordinary chondrite with mafic silicate compositions more magnesian than H chondrites. Burnwell is part of a group of meteorites, along with the previously analyzed Suwahib (Buwah) and Willaroy, that have been termed low-FeO chondrites (Russell et al. 1998) and might represent a fourth ordinary chondrite parent body. Watson is a silicate-bearing IIE iron with large inclusions of broadly chondritic composition, but depleted in metal and troilite (Olsen et al. 1994). Rumuruti (R3-6) is the only fall among the highly oxidized R chondrites, and its bulk composition is reported for the first time, as are Acuña (IIIAB), Elephant Moraine (EET) 87503 (HOW), Felsted (IIIAB, and Old Woman (IIAB). Northwest Africa (NWA) 032 represents a previously unsampled lunar mare deposit and may be the youngest lunar basalt in our collections (Fagan et al. 2002).

The publication of Jarosewich (1990) and the availability of a single set of petrologically and chemically well-characterized meteorites has spurred a number of additional studies, including many aimed at understanding the relationship between asteroids and meteorites. Normative mineralogies were calculated from bulk chemical data of ordinary chondrites using CIPW norms to examine oxidation trends that occurred during formation and to calculate olivine/pyroxene ratios that could be compared directly to spectrally derived ratios from asteroids (McSween et al. 1991). These modes remain the standard for asteroid spectroscopists, owing in large part to the ongoing difficulty of obtaining accurate modes for fine-grained, chondritic meteorites. To further spectral studies, aliquots of the powders have been measured for visible and near-infrared spectra (Burbine et al. 2003) and mid-IR spectra (Salisbury et al. 1991), and these spectra are freely available and widely used for asteroid-meteorite comparisons. The bulk chemical data has been used to model mixing of chondritic materials as possible building blocks of the terrestrial planets (Burbine and O'Brien 2004). Finally, the series of spacecraft missions that began with the NEAR-Shoemaker mission to asteroid 433 Eros and continues with the Hayabusa mission to asteroid 25143 Itokawa has greatly renewed interest in bulk chemical analyses of meteorites that include all of the major elements. The X-ray/gamma-ray instrument on NEAR-Shoemaker derived bulk elemental ratios from Eros' surface (Nittler et al. 2001, 2004; Evans et al. 2001). Bulk, wet chemical data for major elements provided the only direct comparison between Eros and possible chondritic analogs. The methods adopted by the NEAR team will be applied in the future with Hayabusa and the MESSENGER mission to Mercury, emphasizing the need for continued chemical analyses of new meteorites as the diversity of meteorite types expands.

The corrected classification of several meteorites is given to conform to the classification of meteorites, as given in Grady (2000). A detailed outline of preparation of powders, analytical procedures, and discussion of the data are given in an earlier paper by Jarosewich (1990).

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