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Whole Rock Geochemistry and Grain-Size Analyses from Sediment and Rock near Tuba City Open Dump, Tuba City, Arizona

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Abstract

This report releases new information on grain-size distribution and whole rock geochemistry from samples collected in 2008 in and around Tuba City Open Dump, Tuba City, Arizona.

Introduction

A variety of sediment and rock samples were collected in and around Tuba City Open Dump in 2008. Whole rock geochemistry has already been reported for sediment/rock/dune samples in Johnson and others (2008). Many of these samples were sieved in order to get grain-size distributions. The resulting grain-size distributions along with new whole rock geochemistry associated with each grain-size category are provided in this follow-up report. In addition, whole rock geochemistry from cores collected at sites WP-03 and WP-14 and a few X-ray diffraction samples are provided. All sample locations and associated maps are provided in Johnson and others (2008).

Methods and Results

Grain-size analyses were completed using U.S. standard mesh-size sieves on an automatic shaker. Before sieving, aggregated material was broken up in a mortar and pestle as well as possible. The automatic shaker was run until no visible changes in sample size between the sieve sizes was apparent. The resulting data are provided in table 1. Notes are provided in table 1 for coarser material that still appeared to be aggregates, generally of either clayey material or caliche.

Whole rock analyses on the sieved samples were completed by SGS laboratories in Toronto, Ontario, Canada, under contract with the U.S. Geological Survey (USGS) Minerals Program Laboratories in Denver, Colorado. These samples were prepared by air drying and grinding to less than 150 microns, if necessary (Taylor and Theodorakos, 2002), and then digested using multiple acids. The elemental concentrations in the digestion fluid were analyzed using a procedure similar to that of Briggs (2002) using inductively coupled plasma–atomic emission spectroscopy (ICP–AES). The resulting data are provided in table 2. One additional sample (BH10TC001) is reported in table 2. This sample is calcareous cement separated from a conglomerate sample collected from the top of a mesa east of the Tuba City Open Dump site. This sample is matrix material only and all cobbles were removed. Sample BH10TC001 is not on the location maps in Johnson and others (2008), but latitude and longitude values are provided in table 2. In addition, splits from several samples (after drying and grinding) were also submitted to the USGS Minerals Program

Laboratories in Denver, Colorado, for analyses using inductively coupled plasma–mass spectroscopy (ICP–MS) following the procedure described by Briggs and Meier (2002). Results from this limited suite of samples are provided in table 3.

Cores from locations WP-03 and WP-14 were collected using a hollow-stem auger rig. Coring and subsequent monitoring well installations were completed by a contractor for the Bureau of Indian Affairs. Grab samples from the cores were collected by the USGS and submitted for whole rock analyses with ICP–MS. The method for these analyses is the same as described above. Results from these analyses are provided in table 4.

Mineral phases were identified using X-ray diffraction analysis with Material Data, Inc. (MDI) Jade (version 9.1) search-match software from the International Centre for Diffraction Data's "2009 PDF-4" and National Institute of Standards and Technology and Fachinformationszentrum Karlsruhe cooperatively developed Inorganic Crystal Structure Database. Semiquantitative mineral estimates were calculated using MDI Whole Pattern Fit software, which simultaneously calculates a whole pattern fit and a Rietveld refinement of the minerals. Reference minerals are selected from the database, some of which are "structure" references that represent perfect crystals of the mineral, and other entries are more typical mineral specimens. Each reference contains a full crystallographic description of the mineral. A calculated model of the observed pattern is produced by nonlinear, least-squares optimization. The calculations, performed by the software, involve the application of various parameters to improve the fit of the model to the observed data. Modeling parameters include background reduction, profile fitting, and lattice constants. The software iterates and minimizes a residual error between the calculated X-ray diffraction patterns from the selected references in comparison to the measured scan of the sample. All data were normalized to 100 percent based on the identified minerals within a 1-percent error. A full description of the Whole Pattern Fit algorithm is available from MDI (William Benzel, USGS, written commun., 2011). Results from these analyses are provided in table 5.

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