



United States Geological Survey

Reference Material Information Sheet

BHVO-1 (Hawaiian Volcano Observatory Basalt)

Introduction

Material used in the preparation of BHVO-1 was collected from the surface layer of the pahoehoe lava that overflowed from the Halemaumau Crater in Hawaii's Kilauea Caldera in the fall of 1919. Details of the collection, preparation, and initial testing are available in Flanagan (1976).

The USGS has not published a metrologically traceable characterization of the elemental content of this material. The values presented in Table 1 and Table 2 are from published studies that summarize multi-laboratory analyses or literature compilations of mass fraction values for elements in the material. It is recommended that the user of this material consult the references provided to determine the estimated value(s) that are the best fit for their purpose.

Expiry

The material is considered geochemically stable with proper storage.

Contact

Geochemical Reference Materials
Geology, Geophysics, and Geochemistry Science Center
United States Geological Survey
Denver, Colorado USA
g3grm@usgs.gov

Table 1

Estimates of major oxide concentrations in BHVO-1 from published literature

Oxide	Mass Fraction (g/100 g)	Uncertainty (g/100 g)	n ¹	Notes
Al ₂ O ₃	13.69	0.05	46	2,5
CaO	11.43	0.04	48	2,5
FeO	8.58	0.09	12	4,6
Fe ₂ O ₃	2.82	0.24	8	4,6
Fe ₂ O ₃ T	12.32	0.01	42	2,5,7
K ₂ O	0.5256	0.0046	52	2,5
MgO	7.213	0.032	45	2,5
MnO	0.1689	0.0011	42	2,5
Na ₂ O	2.313	0.022	45	2,5
P ₂ O ₅	0.2773	0.0024	42	2,5
SiO ₂	49.79	0.12	43	2,5
TiO ₂	2.742	0.012	60	2,5

Table 2

Estimates of trace element concentrations in BHVO-1 from published literature

Element	Mass Fraction (mg/kg)	Uncertainty (mg/kg)	n ¹	Notes
As	0.565	0.078	7	3,5
Ba	134.4	2.5	5	3,5,9
Be	0.984	0.060	15	3,5,8
Bi	0.0121	0.0015	7	3,5,8
Cd	0.107	0.013	8	3,5
Ce	38.08	0.22	141	3,5
Co	44.90	0.36	75	3,5
Cr	287.6	3.9	92	3,5
Cs	0.1032	0.0026	77	3,5
Cu	137.2	1.6	68	3,5
Dy	5.272	0.034	129	3,5
Er	2.501	0.021	126	3,5
Eu	2.053	0.014	135	3,5
Ga	21.32	0.42	41	3,5
Gd	6.285	0.146	5	3,5,9
Hf	4.44	0.11	8	3,5,9
Ho	0.9839	0.0080	127	3,5
La	15.44	0.10	140	3,5
Li	4.68	0.090	32	3,5
Lu	0.2775	0.0072	9	3,5,9
Mo	1.061	0.059	20	3,5
Nb	18.53	0.23	135	3,5
Nd	24.78	0.26	11	3,5,9
Ni	120.0	1.5	86	3,5
Pb	2.037	0.067	5	3,5,9
Pr	5.419	0.038	124	3,5
Rb	9.52	0.10	127	3,5
Sb	0.155	0.012	14	3,5
Sc	31.42	0.35	77	3,5
Sm	6.165	0.079	12	3,5,9
Sn	2.09	0.15	13	3,5
Sr	399.2	5.0	5	3,5,9
Ta	1.174	0.018	116	3,5
Tb	0.9455	0.0091	130	3,5
Th	1.225	0.017	132	3,5
Tm	0.3289	0.0040	105	3,5
U	0.4182	0.0045	115	3,5
V	313.8	3.2	68	3,5
Y	26.23	0.31	142	3,5
Yb	1.987	0.015	132	3,5
Zn	105.1	1.5	69	3,5
Zr	174.6	1.3	147	3,5

Notes for Table 1 and Table 2

The number of decimal places in mass fraction and uncertainty values are as given in the citation.

- (1) n is the number of laboratory mean estimates that were used to calculate the overall mean and uncertainty of the estimate reported in the cited publication. See the cited publication for details.
- (2) Estimate from Table 3 of Jochum et al. (2016).
- (3) Estimate from Table 4 of Jochum et al. (2016).
- (4) Estimate from Table 2 of Gladney and Roelandts (1988).
- (5) Uncertainty is expressed as 95% confidence level.
- (6) Uncertainty is expressed as one standard deviation.
- (7) Fe₂O₃T is total iron expressed as Fe₂O₃.
- (8) As reported by Jochum et al. (2016), measurements were all made by a single technique (inductively coupled plasma-mass spectrometry).
- (9) As reported by Jochum et al. (2016), measurements were made by isotope dilution-mass spectrometry.

References

References provided in addition to those cited may also be of interest to users of this reference material.

Abbey, S., 1983, Studies in “standard samples” of silicate rocks and minerals 1969-1982: Canadian Geological Survey Paper 83-15, 114 p.

Flanagan, F.J., 1976, Descriptions and analysis of eight new USGS rock standards: U.S. Geological Survey Professional Paper 840, 192 p. [Also available at <https://doi.org/10.3133/pp840>.]

Gladney E.S., and Roelandts, I., 1988, 1987 Compilation of elemental concentration data for USGS BHVO-1, MAG-1, QLO-1, RGM-1, SCo-1, SDC-1, SGR-1, and STM-1: Geostandards Newsletter, v. 12, p. 253-362. [Also available at <https://doi.org/10.1111/j.1751-908X.1988.tb00053.x>.]

Govindaraju, K., 1994, 1994 compilation of working values and sample description for 383 geostandards: Geostandards Newsletter, v. 18, p. 1-158. [Also available at <https://doi.org/10.1046/j.1365-2494.1998.53202081.x-i1>.]

Jochum, K.P., Weis, U., Schwager, B., Stoll, B., Wilson, S.A., Haug, G.H., Meinrat, A.O., and Enzweiler, J., 2016, Reference values following ISO guidelines for frequently requested rock reference materials: Geostandards and Geoanalytical Research, v. 40, p. 333-350. [Also available at <https://doi.org/10.1111/j.1751-908X.2015.00392.x>.]