TRACE ELEMENT ANALYSES OF SOME NORTH AMERICAN TEKTITES

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Few trace element data are available for tektites from North America. Thus we have analyzed nine tektites found in Texas (bediasites) and two found in Georgia. The data are given in Table 1. Samples labeled LET are from Lee County, those labeled GRT are from Grimes County, and that labeled FAT is from Fayette County, all in Texas. Samples labeled DGA are from Dodge County, Georgia. Interpretation of these data awaits completion of major element analyses. Some observations from the data are given below.

1. There are clear compositional differences among the individual samples of tektites analyzed. Taking (arbitrarily) the 6 LET samples as a group, the ratio of highest concentration to lowest concentration for an element ranges from 1.4 for Rb to 2.0 for Cs and Sr. For most elements the range is about 1.7. The two GRT samples fall within the same range. The FAT sample is within the range for all elements except Na, Cs, Th, and Sc, and those are close. The DGA samples fall outside of the range except for Rb and Sr, and Zr. This supports earlier observations of compositional differences between Georgia and Texas tektites (e.g., 1,2).

2. There are clear compositional relationships and trends that extend to the Georgia tektites, suggesting that they are related to the Texas tektites. For example, the relative REE abundances in all 11 tektite specimens are nearly identical to within analytical uncertainties, which are small. The REE abundances are very similar to those of the North American Shale Composite; NASC (3); this includes ratios of Sm to Eu that are typical of Paleozoic and younger sedimentary materials. The REE pattern is observably different from that of the NASC, however, as seen in the top part of Fig. 1. There, the average for the 6 LET tektites is shown, and is seen to have a slightly steeper HREE slope than the NASC. The normalizing concentrations are those of the composite of 9 chondrites (3). In the lower part of Fig. 1, 8 of the individual specimens are shown normalized to the average for the 6 LET tektites. For each tektite, the individual points lie very close to the associated horizontal line, which represents the average of the ratios for individual elements of each tektite to the LET average. (The 3 specimens omitted from the figure show the same REE pattern but would plot too close to one of the others to be distinguishable.)

Several other elements correlate closely with REE concentrations. Correlation coefficients (r^2) for REE with each other are better than 0.99. Correlation coefficients for FeO-Cr and FeO-Sc are better than 0.95, those for FeO-REE, Co-REE, and Sc-Cr are between 0.9 and 0.95, and those for Cr-REE, Co-Cr, Hf-Zr, Hf-REE, FeO-Co, and Th-La are between 0.8 and 0.9. There is a correlation between Na_2O-Sr (0.89) and Na_2O-Ba (0.78) when the Georgia tektites are omitted; those tektites do not lie on that trend. Otherwise, correlations between alkalies and alkaline earths or between those and other elements are very weak or do not exist.

3. There is a good correlation between density and concentrations for many of the elements; the best is with Cr (r^2=.98) as seen in Fig. 2. Correlation coefficients are better than 0.8 for density and REE, FeO, Cr, Sc, Hf, and Co. There is a negative correlation with Ba (r^2=0.77) but no significant correlation with Sr or Na_2O.

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Haskin, L. A. et. al.

The compositional data obtained so far strongly suggest a single, terrestrial source for the REE in these North American tektites. The material that carried the REE was incorporated to varying extents, however, since the concentration range for REE among the tektites is 2.3. Other elements are present in common, terrestrial concentrations as well. Concentration ranges for Sc, FeO, Co, and Cr are 2.4-3.1. What material of nearly homogeneous composition might have been the source for the REE and the elements whose concentrations correlate with theirs? A shale or the clay fraction of a sediment?

References: 1) King, Nature, 210, 828 (1966). 2) King, J. Geophys. Res. 73, 2835 (1968). 3) Haskin et al., in Origin and Distribution of the Elements, L.H. Ahrens, ed. Pergamon, 1968. pp. 889-912.

Table 1. Elemental Concentrations in North American Tektites*

	LET-4	LET-5	LET-6	LET-7	LET-8	LET-9	LET AVE	% σ	GRT-1	GRT-2	FAT-1	DGA-1	DGA-2
FeO	3.10	4.96	5.72	3.74	3.92	4.08	4.3	22	4.07	4.52	5.29	2.09	2.74
Na_2O	1.98	1.30	1.47	1.40	1.76	1.46	1.56	16	1.37	1.56[1]	1.28	1.06	1.06
Rb	70	57	70	56	77	66	66	12	58	64	60	66	64
Cs	2.1	2.8	2.3	1.4	1.8	1.7	2.0	25	2.4	2.8	2.9	1.0	1.2
Sr	180	100	100	90	170	110	125	31	110	140	90	160	160
Ba	580	410	390	450	520	490	470	15	460	490	390	620	590
La	26.5	37.8	45.9	33.9	32.1	34.5	35	18	36.2	42.0	40.3	19.6	22.4
Ce	59	83	97	73	68	73	76	17	81	93	85	43	49
Sm	5.52	7.6	9.6	7.0	6.45	6.9	7.2	19	7.6	8.9	7.8	4.03	4.59
Eu	1.25	1.65	2.02	1.53	1.47	1.55	1.58	16	1.66	1.96	1.63	0.97	1.07
Tb	0.75	1.00	1.31	0.94	0.89	0.94	0.97	19	1.06	1.23	1.06	0.59	0.63
Yb	2.29	3.33	3.93	2.91	2.72	2.83	3.0	19	3.19	3.63	3.37	1.73	2.01
Lu	0.36	0.52	0.62	0.45	0.43	0.45	0.47	19	0.50	0.56	0.52	0.29	0.32
Hf	5.5	7.7	7.8	6.6	6.1	6.4	6.7	14	7.2	6.9	7.8	4.7	5.0
Zr	180	250	290	240	210	220	230	16	230	240	250	160	180
Th	6.2	9.2	9.0	7.1	7.0	7.2	7.6	16	7.8	8.0	9.9	4.9	5.3
U	1.62	2.10	3.1	1.70	1.80	1.83	2.0	28	1.73	2.4	2.6	1.25	1.20
Sc	10.0	16.0	15.7	11.9	12.1	12.6	13	18	12.8	13.8	17.2	6.9	8.3
Co	10.8	14.2	17.8	12.6	12.9	12.4	13.5	18	12.6	15.0	13.7	6.7	7.2
Cr	38	55	68	41	46	46	49	22	46	50	62	22	25

* Values in ppm except Na_2O and total Fe as FeO which are in percent. Analytical uncertainties (1σ) are $\leq$ 2 percent for all elements except Rb, Sm, Yb, Th, U (3%), Ba, Lu (4%), Ta (6%), Cs, Zr (10%), and Sr (20%). Determination was by Instrumental Neutron Activation Analysis.

Fig. 1. Upper: Average REE abundances of Lee Co., Tx. tektites and North American Shale Composite are compared with the average for 9 chondrites. Lower, REE abundances in 8 North American tektites are compred with the average of 6 Lee County tektites. Three other tektites with identical REE patterns have been omitted for clarity.

Fig. 2. The strong relationship between tektite density and composition is illustrated for Cr.