

SOURCE MATERIALS FOR NORTH AMERICAN TEKTITES. ¹R. L. Palma, ¹M. N. Rao, and ²M. W. Rowe. ¹Dept. of Physics, Sam Houston State University, Huntsville, TX 77341. ²Dept. of Chemistry, Texas A&M University, College Station, TX 77843.

We have previously reported the elemental and isotopic compositions of all noble gases in several tektite samples from Bedias, Texas [1]. However, these experiments had relatively high Kr and Xe blank levels compared to sample concentrations. Special efforts have been made to reduce instrument blank levels to <50% of the Kr and Xe signals obtained from tektite samples. Under these relatively low blank conditions we have measured the noble gas abundances in three bediasites and two georgiaites. Prior to this study there existed only one heavy noble gas measurement on North American tektites [2]. For comparison, an Ivory Coast tektite has also been measured. The abundances and isotopic compositions of all the noble gases in these tektites are reported and compared with tektites from other strewn fields. Important findings of this study are enormous enrichments of Ne relative to Ar and progressive enhancements of Kr and Xe relative to Ar (all data normalized to air ratios). This noble gas fractionation pattern seems to be a common feature of shales and sedimentary rock material [3, 4], and thus may provide clues as to the source materials from which the North American tektites were created by impact.

The bediasites analyzed, Bedias 3, 4, and 5, are from Grimes County, Texas. Georgiagate Ga-2341 (USNM 2341) is from Rock Branch Church, Dodge County, Georgia; and Ga-2345 (USNM 2345) is from near Jay Bird Springs, Dodge County, Georgia. The Ivory Coast tektite, IC-6011 (USNM 6011) is from Ouellé, Ivory Coast. The georgiaites and the Ivory Coast sample were kindly provided by Roy Clarke of the USNM.

Standard sample preparation and mass spectrometric procedures have been used and are described in detail elsewhere [5]. The Kr and Xe background values were typically 2.7×10^{-11} ccSTP ^{84}Kr and 3.8×10^{-12} ccSTP ^{132}Xe . Background corrections for ^4He were 40-70%; <2% for ^{20}Ne ; 10-30% for ^{36}Ar ; 10-25% for ^{84}Kr ; and 15-45% for ^{132}Xe . Estimated uncertainties in the absolute gas concentrations are 20% for ^4He , 8% for ^{20}Ne and ^{36}Ar , and 12 to 15% for ^{84}Kr and ^{132}Xe . Sample masses were typically 2 to 3 grams, depending on availability.

All noble gas isotopic compositions in each sample were atmospheric. Figure 1 compares the noble gas abundance patterns in different North American tektite samples by plotting the fractionation factor $F(m) = [({}^m\text{X}/{}^{36}\text{Ar})_{\text{sample}}] / [({}^m\text{X}/{}^{36}\text{Ar})_{\text{air}}]$ versus mass where ${}^m\text{X}$ represents a noble gas isotope of mass "m". All samples show the enormous Ne enrichments relative to Ar observed in other tektite samples [6, 7]. This Ne enrichment is generally attributed to the large diffusion coefficient for Ne in these glasses after solidification. However, part of this excess could be due to Ne trapped in a shale precursor material which at the time of impact was only partially degassed, since some sedimentary rocks and shales contain large amounts of trapped Ne [3].

The major significance of this study is the heavy noble gas fractionation pattern observed in Figure 1. The systematic increase of Kr and Xe relative to ^{36}Ar seems to be a distinguishing characteristic of North American tektites. In bediasites and georgiaites $F(m)$ factors for Kr range from 10 to 30, and for Xe, from 100 to 300. In comparison, for all other strewn fields $F(m)$ values for Kr range from 1 to 5, and for Xe, from 2 to 30. The Ivory Coast tektite sample analyzed here also shows heavy noble gas fractionation factors similar to those seen in non-North American tektites. Further, we have shown that these Kr and Xe enrichments relative to ^{36}Ar are not due to ^{36}Ar depletion [5].

The heavy noble gas abundances are relatively unaffected by diffusion and other fractionation mechanisms, so it is striking that the noble gas fractionation observed in a large number of shales and sedimentary rocks [4, 8] closely resembles the fractionation pattern observed in North American tektites. The progressively greater enhancement of Kr and Xe, accompanied by a much greater enhancement of Ne, is a modified "normal" pattern [4]. This close similarity of noble gas fractionation patterns suggests that the parent material from which these tektites are generated by impact is probably the shale or sedimentary material situated on

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the eastern part of the North American continent. The Kr/Ar and Xe/Ar ratios observed in shales do not seem to fractionate significantly in the impact generated melts which lead to the formation of tektite glasses. The large Ne enhancements seen are mostly due to an independent process, i.e., diffusion into these glasses after solidification. The occurrence of tektite glass fragments in the core samples of DSDP Site 612 [9] and the Nd and Sr based model ages of North American tektites and DSDP Site 612 microtektites [10] suggest that the source sediments for these tektites are from the eastern or southeastern part of the North American continent. Our noble gas fractionation pattern data are consistent with such a conclusion.

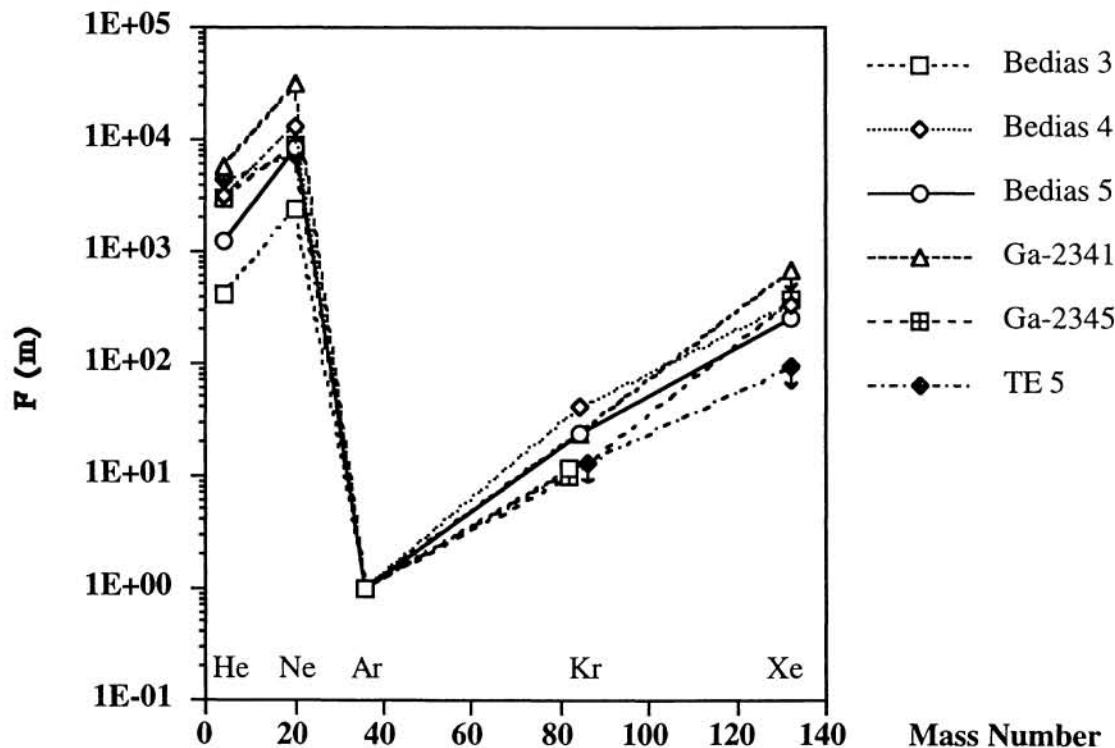


FIG. 1 North American tektite elemental noble gas abundance pattern displayed by fractionation factor $F(m)$. Bediasite TE5 analyzed by Matsubara and Matsuda (1991). Arrows indicate upper limits due to over 50% blank signal contributions.

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