I. BACKGROUND

The Setters Formation is a 0-750 ft thick, Cambro-Ordovician, metasedimentary unit that comprises interbedded massive quartzite and schist. Because the Setters breaks easily along the schist foliation plane to form flagstone slabs, the rock has been historically quarried for construction material. The Setters Formation is found outcropping to the north and west of Baltimore, MD. Sample collection for this research project focused on the Woodstock Dome, located west of Baltimore.

II. PROBLEM & HYPOTHESES

Petrogenesis of the Setters Formation has not been thoroughly studied and the origin of the tourmaline phase is not well understood. Chemical analysis of the Setters Formation tourmaline has been used to test the following hypotheses:

1. Tourmaline in the amphibolite-grade metasediments of the Setters Formation exhibits a compositional range along the schorl-dravite solid-solution series, being consistent with previously studied psammites and metapsammites (Witherspoon 1995).

2. Chlorite-normalized REE patterns in tourmaline from the Setters Formation reflect distinct REE patterns associated with metasedimentary host rock.

3. Measurements of boron isotopes in tourmaline from the Setters Formation compared to reference materials to determine the boron to be isotopically heavy associated with a seawater source (611B –80).

III. MAJOR ELEMENT ZONING

Plot of the REE trends for Setters tourmaline, with published data from tourmalines in metapelites (Hazarka et al. 2015) and pegmatites (Marks et al. 2013), and seawater (Goldstein & Jacobsen 1988).

IV. TOURMALINE SPECIATION

Al-Fe-total-Mg diagram (molar proportions) for Setters tourmalines along the schorl-dravite solid-solution and primarily within zones 4 and 5. Zones represent 4) metapelites and metapsammites, 5) metapelites and metapsammites (without Al-saturating phase), as defined by Henry and Guidotti (1985).

V. TOTAL Fe VS Mg

Plot of Fe vs. Mg in tourmaline (plotted based on amount per formula unit, apfu). Fe/Mg ratios for all samples fall in the intermediate range. Distinct compositional variations are represented by the datasets for each location sampled.

VI. RARE EARTH & TRACE ELEMENTS

Chondrite-normalized REE patterns for tourmaline in the Setters Formation are consistent with previously studied pelites and metapelites as determined by EMPA analysis. Chondrite-normalized REE patterns for tourmaline in the Setters Formation reflect distinct REE patterns associated with metasedimentary host rock.

VII. BORON ISOTOPES

Boron isotope ratio measurements for tourmaline collected in situ using LA-ICP-MS was developed during this study. The measurements of boron isotopes in tourmaline from the Setters Formation compared to reference materials show the boron to be isotopically light (613B –90) and possibly formed from fluid derived from continental margin sediments and maﬁc volcanic ash.

VIII. DISCUSSION

Analysis of Setters tourmaline indicates that distinct compositional variations exist on a local scale. These distinct variations are reﬂected in the major- and minor-element, and REE data. Correlations between major-element composition and REE abundances appear to be present: JFB-15-2 has the highest Al content and the highest REE abundance of the three sites sampled.

Due to the sampling techniques used, the relationship between compositional variation and schist horizons cannot be directly associated. However, there is evidence to indicate that this variation in composition may be present on a sub-meter scale.

IX. CONCLUSIONS

Compositional ranges of tourmaline from the Setters Formation are consistent with previously studied pelites and metapelites as determined by EMPA analysis. A procedure for measuring 611B values using LA-ICP-MS was developed during this study. The measurements of boron isotopes in tourmaline from the Setters Formation compared to reference materials show the boron to be isotopically light (613B –90) and possibly formed from fluid derived from continental margin sediments and maﬁc volcanic ash.