Relating the Crystallography and Chemistry of the Tourmaline Mineral Group

Vandivier, Connor J.; Dr. Christine M. Clark; Department of Geography and Geology, Eastern Michigan University

Abstract

Tourmaline is an important mineral group due to its unique characteristics such as piezoelectric qualities, hardness, and its ability to essentially "record" geologic information. Until around ten years ago, only about fifteen species of this mineral were known. Within the last decade, however, over thirty more were identified. The speed at which these discoveries have been made, combined with advances in technology, have allowed the crystal structure of this mineral to be more deeply understood. What my research entails is relating the crystallography of tourmaline to its chemical composition, and assuring that assumptions previously made relating the two are correct.

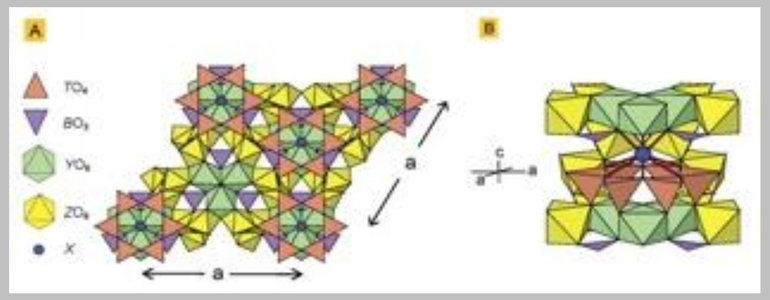
Statement of Problem

- Rapid discoveries in tourmaline have brought new understanding to the structure of the mineral group.
- Older tourmalines may therefore have inaccurate chemical and crystallographic data.

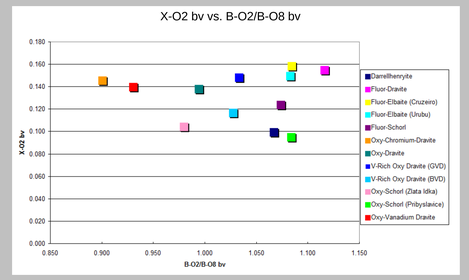
Tourmaline Chemistry

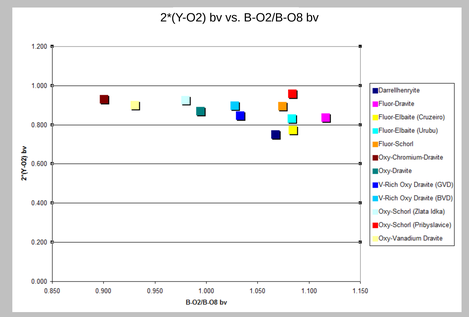
Species	End-Member Formula
Darrellhenryite	$Na(LiAl_2)Al_6(Si_6O_{18})(BO_3)_3(OH)_3O$
Fluor-dravite	$Na(Mg_3)Al_6(Si_6O_{18})(BO_3)_3(OH)_3F$
Fluor-elbaite	$Na(Li_{1.5}Al_{1.5})Al_6(Si_6O_{18})(BO_3)_3(OH)_3F$
Fluor-schorl	$Na(Fe^{2+}{}_3)Al_6(Si_6O_{18})(BO_3)_3(OH)_3F$
Oxy-chromium-dravite	$Na(Cr_3)(Cr_4Mg_2)(Si_6O_{18})(BO_3)_3(OH)_3O$
Oxy-dravite	$Na(MgAl_2)(MgAl_5)(Si_6O_{18})(BO_3)_3(OH)_3O$
Oxy-schorl	$Na(Fe^{2+}{}_2Al)Al_6(Si_6O_{18})(BO_3)_3(OH)_3O$
Oxy-vanadium-dravite	$(Na)(V_3)(V_4Mg_2)(Si_6O_{18})(BO_3)_3(OH)_3O$

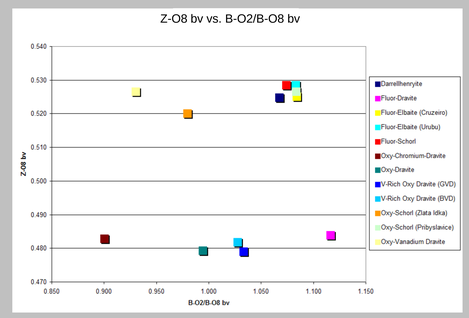
Tourmaline Structure

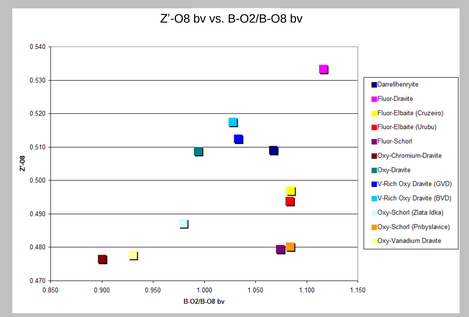


Bond Valence Graphs

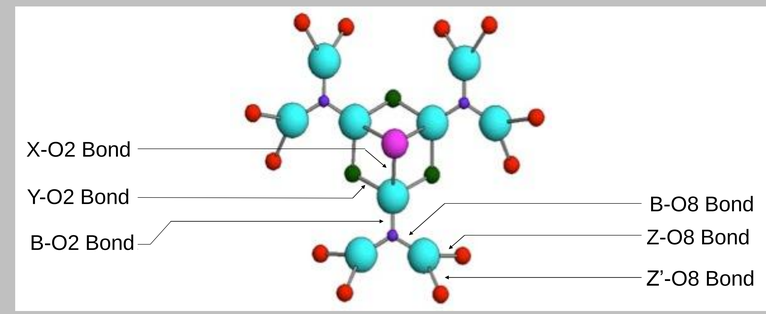








Tourmaline Structure Fragment



Future Work

- Continue compiling new tourmaline chemistry and structures
- Re-examine tourmaline structure database to verify Z vs. Z' designation
- Run statistical analysis of updated database to determine which independent variable has the greatest control over the stereochemistry of the BO_3 triangle
- Examine results of statistical analyses. This information will be used to further our understanding of the stereochemistry and relationships of the ions in the tourmaline structure

References & Acknowledgements

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