The chemistry, chemical variations and implications of groundmass spinels within contrasting facies of the X-Ray Kimberlite, Attawapiskat, Ontario

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The Attawapiskat Kimberlite Field (AKF) hosts Ontario's only diamond producing mine and contains several known kimberlites, among these is the X-Ray kimberlite (XRK) that was intruded into Ordovician to lower Silurian limestones during the Jurassic period. The XRK is composed of at least three volcaniclastic facies (presented from oldest to youngest: Xr3VK, Xr2VK and Xr1VK) all of which consist of heterogeneous lapilli-tuffs. Each facies represents a distinct intrusive event and all three can be distinguished from one another based on contact relationships and associated textures. With regards to mineralogy, they are composed of both xenocrystic minerals (paragenesis 1) and groundmass minerals (paragenesis 2) that can involve both primary and secondary minerals. This includes groundmass spinels, which can serve as essential tools to further define the evolution of the kimberlite when examining the variations of the spinel chemistry and textures (notably Cr-bearing spinels and magnetites). Primary spinels within the XRK consist of small (~40 μm) euhedral chromites and Cr-bearing spinels with ferritchromite alteration rims, whereas the secondary spinels consist of anhedral magnetites. Further evaluation of the chemical changes that occur within spinel paragenesis will be used to evaluate whether correlation exists between the different alteration minerals prominent within the matrix, interaction of the limestone country rock and magmatic/phreatomagmatic eruption features. When comparing the features present in each host facies, a broader paragenesis of the XRK will be developed and can serve as a basis from which an understanding of the complex interrelationship may be discerned. Detailed analyses of each kimberlite facies, focusing on the spinel occurrences, were performed by petrographic analysis of polished thin sections (PTS) using transmitted and reflected light microscopy to document textural (crystal habit, grain size, modal abundance, inclusions and alteration) and geological (mineralogy and lithologies) features of the spinels. Scanning electron microscope energy dispersive spectrometry (SEM-EDS) as well as wave-length-dispersive spectrometry (WDS) with an electron microprobe will be used to document the chemical variations (major, minor and trace-element). By providing detailed information of the crystal chemistry of Cr-bearing spinels and magnetites in correlation with their paragenesis and spatial distribution within all three individual facies, it is possible to develop a more comprehensive approach towards understanding how different kimberlite facies are emplaced and evolve through time.