Paper Number: 3346

The formation of gahnite (Zn-spinel) and Zn-bearing staurolite in the Big Syncline East, Aggeneys terrane, Namaqua Metamorphic Complex, South Africa

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The Aggeneys terrane (Namaqua Metamorphic Complex, South Africa) is well known for hosting rich base metal massive sulphide deposits. Zincian spinels (end-member gahnite, $ZnAl_2O_4$) are reported as being good indicator minerals for metamorphosed massive sulphide deposits because of their association with Zn-Fe sulphides. The study area is underlain by the Bushmanland Group, which is composed of multiply-deformed amphibolite facies metasedimentary rocks, together with associated granitic gneisses forming the basement.

The compositional range of gahnite ($gahnite_{38-75}hercynite_{20-50}spinel_{5-17}$) plots within the field of metamorphosed massive sulphide deposits within Fe-Al metasedimentary and metavolcanic rocks as defined by [1]. These authors further assert that gahnite is buffered by associated Zn-Fe sulphides, however the gahnite-bearing rocks from this study do not display any macro- and microscopic textural evidence for associated Zn-Fe sulphides.

Zn-bearing staurolite occurs in association with garnet as poikiloblastic grains with inclusions of gahnite, opaque minerals (Zn-baring Mn-ilmenite) and quartz (Figure 1). The relationship between gahnite, staurolite and the Zn-bearing Mn-ilmenite indicates that staurolite had formed from the breakdown of gahnite and possibly from Zn-bearing Mn-ilmenite.

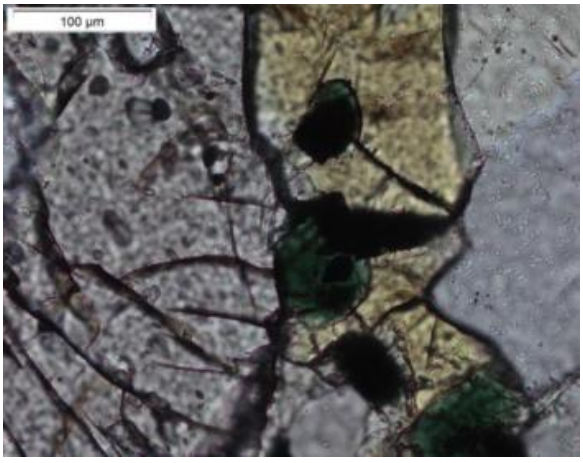

Figure 1: gahnite inclusions (green) in staurolite (yellow) near garnet.

Fine-grained opaque minerals included in gahnite are mainly Zn-bearing Mn-ilmenite and these inclusions have a higher Zn-content than the matrix grains.

The compositions and textural evidence of both gahnite and Zn bearing Mn-ilmenite suggests that these two minerals did not coexist in equilibrium, but rather that gahnite formed from the breakdown of Zn-ilmenite in these sulphur-deficient rocks.

References:

[1] Heimann et al. (2005) Can Min 43:601-622.