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Counting Garnets: A New Nomenclature of the Garnet Supergroup

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The garnets pose somewhat different nomenclature problems than other mineral supergroups recently considered for nomenclature review, e.g., sapphirine, apatite, pyrochlore, tourmaline, and amphibole. In contrast to the structures of the minerals in these groups, the archetypal garnet structure, cubic space group Ia-3d (no. 230), has only four sites and eight cations: {X3}[Y2](Z3)φ12, where X, Y and Z refer to dodecahedral, octahedral and tetrahedral sites, respectively, and φ is O, OH or F. This structure is remarkably flexible in that 59 elements have been reported in both natural and synthetic compounds, which have found wide application in science (geothermobarometry of metamorphic rocks), industry (abrasives), technology (solid state laser crystals, magneto-optic material for holographic storage, magnetic field sensors, detectors for medical computer tomography) and culture (gems). Garnet was known in antiquity (carbunculus, anthrax), and more than 714 names have been used since. The garnet supergroup approved by the Commission on New Minerals, Nomenclature and Classification of the International Mineralogical Association (proposal 11-D) recognizes 32 species, all minerals isostructural with silicate garnet regardless of what elements occupy the four atomic sites, with an additional 4 possible species needing further study. Total charge at the Z site and symmetry are criteria for distinguishing groups, whereas the dominant-constituent and dominant-valency rules can be used to determine the species, but often species identification depends on the relative proportions of end-member components, which are especially critical to recognizing species within the three most complex groups. Two OH-bearing species (henritermierite and holtstamite) have tetragonal symmetry, space group I4(1)/acd (no. 142), and constitute one group; their X, Z and φ sites are split into more symmetrically-unique atomic positions. Twenty-seven other species belong to one of four groups: bitikleite, schorlomite, garnet and berzeliite with a total charge at Z of 9, 10, 12 and 15, respectively. Katoite, cryolithionite and yafsoanite are single representatives of potential groups in which Z is vacant or occupied by monovalent or divalent cations, respectively. We recommend that suffixes (other than Levinson modifiers) not be used in naming minerals in the garnet supergroup. Existing names with suffixes have been replaced with new root names where necessary: bitikleite-(SnAl) to bitikleite, bitikleite-(SnFe) to dzhuluite, bitikleite-(ZrFe) to usturite and elbrusite-(Zr) to elbrusite. The name hibschite has been discredited in favor of grossular as Si is the dominant cation at the Z site. Except for these changes, existing names are retained, whereas end-member formulae are revised to the form {X3}[Y2](Z3)φ12. Eighteen end-members have been reported as subordinate components in minerals of the garnet supergroup and many of these end-members have been synthesized, which implies the potential for more species to be discovered in the garnet supergroup.