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"Named Amphiboles": A new category of amphiboles recognized by the International Mineralogical Association (IMA) and a defined sequence order for the use of prefixes in amphibole names

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ABSTRACT

A new category of "named amphiboles" whose names can be published without previous approval by the IMA-CNMMN, is now recognized by the IMA-CNMMN, so long as the names agree with the IMA-CNMMN-approved system of amphibole nomenclature. Generally there will be only a chemical composition and monoclinic or orthorhombic symmetry known. These are not new amphibole species and the criteria for recognition by the IMA-CNMMN of new amphibole species remain unchanged. In addition, for the first time, the sequence order in which prefixes appear in amphibole names, whether in species or in "named amphiboles," is defined and applies immediately.

The extensive solid solutions shown by the amphiboles together with their widespread occurrence has presented particular difficulties in devising a rational nomenclature for the group. Consequently it was not until 1978, after 13 years of work, that the IMA-CNMMN was able to first approve a systematic amphibole nomenclature (Leake 1978). After 15 years of further work, the scheme was developed, refined, simplified, and adjusted for newly discovered species, giving the present scheme detailed in Leake et al. (1997, 2004). This scheme consists of 34 root names (e.g., glaucophane) with a range of compulsorily used prefixes (e.g., ferro) to indicate particular richness in certain elements (to avoid unnecessary proliferation of the already large number of root names), and several optionally usable modifiers (e.g., titanian) for less important substitutions. Prefixes are an essential part of a mineral name (Nickel and Grice 1998). Only when new substitutions are discovered that involve ionic charge distributions of a new type, are new root names now approved for amphibole species. All new species names, whether a new root name is involved or simply an existing root name with a particular prefix not previously approved with that root name, require to be submitted to the IMA-CNMMN for approval before publication. Such new species are only approved, as for any other mineral, if accompanied by an acceptable variety of defining features such as chemical composition, crystal symmetry, cell sizes, XRD patterns, etc.

Although the amphibole naming scheme has been widely accepted and generally successful in bringing order to names within this group, a few problems have arisen. In particular, the following situation has become increasingly common. If a new amphibole composition is discovered, for instance by electron microprobe analysis, that yields an existing root name prefixed for the first time by one of the IMA-CNMMN-approved prefixes, or a certain combination of such prefixes, which have therefore not been previously submitted to the IMA-CNMMN with this root name for approval, then naming can become a problem. The discoverers may not have the time, inclination, equipment, expertise or adequate sample, to carry out the full range of tests to ensure approval by the IMA-CNMMN as a new species. If they submit an account of their work for publication and include the new name, correctly deduced according to the current IMA-CNMMN scheme, it is commonly published if the editor and referees are not aware of IMA-CNMMN rules. This is the usual situation at present and has yielded dozens of "unapproved," but usually "correct" names whose status is ambiguous. If the editor or referees are aware of the IMA-CNMMN rules, the new name is refused publication until IMA-CNMMN approval as a new species is obtained. The author(s) rarely submit such names to the IMA-CNMMN, and in order not to delay publication of their paper, generally resort to removing the name and referring to the composition in very general terms ("a sodic amphibole"') which the journal accepts. This means that the special character, the solid solution extension involved, and the name of the particular composition is not brought to the attention of others and is potentially lost. This second possibility has occurred several times.

To resolve such problems and the present widespread flouting of IMA-CNMMN rules, the IMA-CNMMN has now agreed to institute a new category of "named amphiboles" that can be published without requiring individual IMA-CNMMN approval. These names will be limited to amphibole compositions which, when correctly calculated, yield an already IMA-CNMMN-approved root name, but with a certain IMA-CNMMN approved prefix, or a certain combination of approved prefixes, not previously approved with that root name. In addition, the monoclinic or orthorhombic symmetry must be known. Such names will not

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be new amphibole species nor have the requirements for approval of new amphibole species been changed in any way. New root names will continue to be approved only for new (= those not included in the 1997 and 2004 schemes) heterovalent substitutions. "Named amphiboles" cannot involve new root names not already approved by the IMA-CNMMN. As most "named amphiboles" will not have been vetted by the IMA-CNMMN before publication (as is the present position with the publication of unapproved names), the IMA-CNMMN cannot guarantee that such names have been correctly deduced. However, from time to time, in order to alert the mineralogical community to the observed solid solution ranges within the amphibole group, informal lists of previously published, or known, "named amphiboles" will be published by the IMA-CNMMN. Such lists will only include names which, when correctly given according to current IMA-CNMMN rules, constitute for the first time new names, not previously recognized as species. In such lists the sequence in which multiple prefixes are written will follow the order detailed below, whether or not the original publication adhered to that order. Lists may include names already published before this new category of "named amphiboles" was agreed, in an attempt to "regularize" the otherwise ambiguous names already in the literature. However, named amphiboles will not be included in official IMA-CNMMN lists as they are not approved species. Authors not seeking approval for amphibole names run the risk that other researchers will submit their own material for species approval with the same name.

Sequence order of prefixes

The IMA-CNMMN amphibole-naming system involves three types of prefixes. Primary prefixes are an essential part of the root name ("root name prefixes"), generally a ferro or magnesio prefix, and all such names appear in the IMA-CNMMN classification diagrams that are widely used by the community; thus ferro-anthophyllite, magnesiohastingsite. Then there are the secondary prefixes of proto (*Pnmn* orthorhombic form instead of the usual *Pnma* form), magno, and parvo (Group 5 amphiboles with $^{B}Li <= 0.50$, which retain their traditional Group 1, 2, or 3 root names because Group 5 was approved to accommodate ^{B}(LiNa) amphiboles; Leake et al. 2004). Finally, there are prefixes such as potassic, titano, chloro, and ferri, which indicate richness in particular elements. The minimum element cell content needed to trigger these names is set to bring out only exceptional richness in the groups concerned and so some of the tertiary prefixes do not apply to all the amphibole groups or root names.

Previously, the order in which prefixes were used when more than one prefix was present was not specified except that it was generally understood by usage that root name prefixes always came immediately before the root names so that the names given in the classification diagrams were not split apart. With increase in the number of approved new species names and with the expected number of "named amphiboles," it has become apparent that systematic listing (e.g., alphabetic), indexing, searching for, and recognition of, amphibole names, is being made much more difficult by the lack of any system in the ordering of prefixes.

Accordingly, the IMA-CNMMN has now approved a standard sequence for prefixes. This recognizes that root name prefixes should never be split apart from their root names, and that many elements are not confined to one of the M1, M2, M3, or M4 positions. The convention of not hyphenating the prefix nearest to the root name (e.g., ferrogedrite), except when two vowels adjoin (e.g., ferro-eckermannite), or it might be unclear, is retained. The prefix order should be:

1. The first prefix should always be any proto, magno, or parvo prefix if required;

2. Next should be any anion prefix, i.e., chloro, fluoro, or oxy if required;

3. Next comes any necessary cation prefix, e.g., potassic (if more than one, then in alphabetical order), except any trivalent substitutions and root name prefixes;

4. Necessary trivalent substitutions, i.e., alumino, ferri, mangani, and chromio, come next, immediately before rule 5;

5. Any root name prefixes immediately precede the root name, e.g., ferrowinchite.

Although this suggests fiendishly complicated names with multiple prefixes, in fact over 90% of published amphibole names have either no prefix at all, one root name prefix only or one root name prefix plus a second prefix. The number of prefixes on new names now submitted to the IMA-CNMMN for approval tends to be larger because they are more often rare and unusual compositions, infrequently encountered, whereas for most everyday usage, more than two prefixes is distinctly rare, and about half the names lack any prefix, e.g., Bosch et al. (2004).

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