# Mineral statistics

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For mineralogists and mineral collectors who are statistically inclined, the number of valid mineral species at any given time is always of interest, as is the breakdown of these species by chemical groups and according to representation of various elements in mineral formulas. A recent article published in Russian (Yaroshevsky 2003) presents this interesting information on mineral species considered valid to the end of 2001. Since it may be of interest to our members, the information was updated and expanded to the present (approximately to mid-2003). The updated classification of species is shown in Table 1. The data presented by Yaroshevsky on the chemical elements represented in mineral formulas was completely resorted and retabulated. Revision and reworking was necessary to bring the data up to date, to correct some discrepancies, and to give a full breakdown of the rare-earth elements (Y + REE), which were grouped together in a single entry in the Yaroshevsky paper. Data shown in Table 2 were extracted electronically from web-based mineral databases (both MINDAT and Athena), and for the new species not yet included in the databases, manually from original descriptions and related literature (Mandarino 2003, Martin 2003). The inherent problem here of course is the integrity and completeness of data in the databases used; therefore the numbers presented here are as accurate as the databases used. Another problem which may affect data in Table 2 involves the differences in mineral formulas, which change and evolve over time, and may vary from one reference or database to the next. For example, of the standard references, Gaines *et al.* (1997) give the following formula for the mineral leucophanite: $CaNaBe(Si_2O_8F)$, Anthony *et al.* (1995) give $(Ca,Ce)CaNa_2Be_2Si_4O_{12}(F,OH)_2$, and Mandarino (1999) gives $(Ca,REE)CaNa_2Be_2Si_4O_{12}(F,O)$. A search for elements in a database using data in Gaines *et al.* (1997) will not show Ce and H, one based on Mandarino (1999) may or may not show Ce and will not show H, whereas that based on Anthony *et al.* (1995) will show both Ce and H.

The number of valid and published species given by Yaroshevsky to the end of 2001 is 3966 species. The 2002 and partial 2003 additions (Martin 2003) bring this number to 4051. Considered valid are those published species that were approved or "grandfathered" by IMA CNMMN. The estimated 40 to 60+ recently (or not so recently) approved but unpublished species are not included in the data presented here.

## References

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**Table 1. Chemical classification of minerals**

| Minerals | Number of species | % of total |
|---|---|---|
| Elements and alloys | 94 | 2.32 |
| Carbides | 7 | 0.17 |
| Nitrides | 10 | 0.25 |
| Phosphides | 8 | 0.20 |
| Silicides | 5 | 0.12 |
| Sulfides, selenides and tellurides | 287 | 7.09 |
| Arsenides, antimonides and bismuthides | 70 | 1.72 |
| Sulfosalts | 248 | 6.12 |
| Fluorides | 52 | 1.28 |
| Chlorides | 82 | 2.02 |
| Bromides | 7 | 0.17 |
| Iodides | 6 | 0.15 |
| Oxides | 269 | 6.64 |
| Hydroxides | 198 | 4.88 |
| Nitrates | 16 | 0.40 |
| Borates | 137 | 3.38 |
| Carbonates | 203 | 5.02 |
| Iodates | 11 | 0.27 |
| Sulfates | 298 | 7.35 |
| Selenites and selenates | 21 | 0.52 |
| Tellurites and tellurates | 53 | 1.31 |
| Chromates | 12 | 0.30 |
| Phosphates | 409 | 10.10 |
| Arsenites and arsenates | 255 | 6.30 |
| Vanadates | 80 | 1.98 |
| Molydates | 26 | 0.64 |
| Tungstates | 13 | 0.32 |
| Silicates | 1136 | 28.04 |
| Organic minerals | 38 | 0.94 |
| Total | 4051 | 100 |

## Table 2. Elements represented in mineral formulas

| Element | Atomic number | Rank | Number of species | Element | Atomic number | Rank | Number of species | Element | Atomic number | Rank | Number of species |
|---|---|---|---|---|---|---|---|---|---|---|---|
| H | 1 | 2 | 2226 | Cu | 29 | 10 | 516 | La | 57 | 40 | 80 |
| Li | 3 | 35 | 91 | Zn | 30 | 20 | 225 | Ce | 58 | 26 | 165 |
| Be | 4 | 34 | 94 | Ga | 31 | 65* | 5 | Pr | 59 | 64* | 2 |
| B | 5 | 23 | 217 | Ge | 32 | 52 | 20 | Nd | 60 | 48 | 39 |
| C | 6 | 16 | 334 | As | 33 | 13 | 454 | Sm | 62 | 61* | 5 |
| N | 7 | 42 | 75 | Se | 34 | 32 | 104 | Gd | 64 | 59 | 7 |
| O | 8 | 1 | 3249 | Br | 35 | 54* | 15 | Dy | 66 | 61* | 5 |
| F | 9 | 17 | 281 | Rb | 37 | 62* | 3 | Er | 66 | 64* | 2 |
| Na | 11 | 8 | 703 | Sr | 38 | 33* | 103 | Yb | 70 | 60 | 6 |
| Mg | 12 | 9 | 647 | Y | 39 | 33* | 103 | Hf | 72 | 62* | 3 |
| Al | 13 | 7 | 834 | Zr | 40 | 39 | 85 | Ta | 73 | 41 | 77 |
| Si | 14 | 3 | 1176 | Nb | 41 | 31 | 129 | W | 74 | 49 | 34 |
| P | 15 | 12 | 474 | Mo | 42 | 48 | 40 | Os | 76 | 58 | 10 |
| S | 16 | 6 | 878 | Ru | 44 | 54* | 15 | Ir | 77 | 51* | 21 |
| Cl | 17 | 18 | 280 | Rh | 45 | 53* | 16 | Pt | 78 | 45 | 44 |
| K | 19 | 15 | 359 | Pd | 46 | 44 | 59 | Au | 79 | 50 | 30 |
| Ca | 20 | 5 | 1014 | Ag | 47 | 29 | 136 | Hg | 80 | 37 | 88 |
| Sc | 21 | 57 | 11 | Cd | 48 | 53* | 16 | Tl | 81 | 46 | 43 |
| Ti | 22 | 19 | 259 | In | 49 | 56 | 12 | Pb | 82 | 14 | 425 |
| V | 23 | 28 | 153 | Sn | 50 | 36 | 89 | Bi | 83 | 24 | 187 |
| Cr | 24 | 38 | 84 | Sb | 51 | 21 | 224 | Th | 90 | 47 | 41 |
| Mn | 25 | 11 | 507 | Te | 52 | 30 | 135 | U | 92 | 22 | 218 |
| Fe | 26 | 4 | 1036 | I | 53 | 51* | 21 | | | | |
| Co | 27 | 43 | 61 | Cs | 55 | 55 | 14 | | | | |
| Ni | 28 | 27 | 157 | Ba | 56 | 25 | 180 | | | | |

Total number of elements represented in mineral formulas: 72
Note: the * after numbers denotes ranking shared with one or more elements.