

## MINERALS PRESENTED IN GEO 2163

You are responsible for being able to identify ALL these minerals in hand sample. This requires knowledge of all their physical and chemical properties, as well as common associations and the rock type they are commonly found in.

For a certain number of these minerals, you must know the chemical formula and/or the crystal system and point group. This information is fair game on quizzes and exams. These have been indicated below. For all others, the name is sufficient.

### NON-SILICATES

| MINERAL                        | ID#       | FORMULA             | CRYSTAL SYSTEM/POINT GROUP |
|--------------------------------|-----------|---------------------|----------------------------|
| <b>Native elements</b>         |           |                     |                            |
| Graphite (in metamorphic rock) | 1242      | C                   | Hexagonal, $6/m2/m2/m$     |
| Native copper                  | 1114      | Cu                  | Cubic, $4/m\bar{3}2/m$     |
| Sulphur                        | 1231      | S                   | Orthorhombic, $2/m2/m2/m$  |
| <b>Sulphides</b>               |           |                     |                            |
| Pyrite (in slate)              | 2911a     | FeS <sub>2</sub>    | Cubic, $2/m\bar{3}$        |
| Pyrite (massive)               | 2911b     |                     |                            |
| Galena                         | 2611a     | PbS                 | Cubic, $4/m\bar{3}2/m$     |
| Sphalerite (light brown)       | 2621a     | ZnS                 | Cubic, $\bar{4}3m$         |
| Sphalerite (dark brown)        | 2621b     |                     |                            |
| Chalcopyrite                   | 2631      |                     |                            |
| Pyrrhotite                     | 2651      | Fe <sub>1-x</sub> S | Monoclinic, Hexagonal      |
| Bornite                        | 243       |                     |                            |
| Cinnabar                       | 269       |                     |                            |
| Realgar                        | 26.10     |                     |                            |
| Arsenopyrite                   | 2951      |                     |                            |
| Molybdenite                    | 2961a & b | MoS <sub>2</sub>    | Hexagonal, $6/m2/m2/m$     |

| MINERAL                                 | ID#       | FORMULA  | CRYSTAL SYSTEM/POINT GROUP |
|---|-----------|--|----------------------------|
| <b>Oxides</b>                           |           |  |                            |
| Hematite                                | 4412a     | Fe <sub>2</sub> O <sub>3</sub>                               | Hexagonal                  |
| Hematite (var. specularite)             | 4412b     |  |                            |
| Spinel (with forsterite and calcite)    | 7211      | MgAl <sub>2</sub> O <sub>4</sub>                             | Cubic, $4/m\bar{3}2/m$     |
| Magnetite                               | 7216      | Fe <sub>3</sub> O <sub>4</sub>                               | Cubic, $4/m\bar{3}2/m$     |
| Chromite                                | 721.12    | FeCr <sub>2</sub> O <sub>4</sub>                             | Cubic, $4/m\bar{3}2/m$     |
| Ilmenite                                | 4413a     | FeTiO <sub>3</sub>   |                            |
| Corundum (barrel-shaped crystal)        | 4411a     | Al <sub>2</sub> O <sub>3</sub>                               | Hexagonal, $6/m2/m2/m$     |
| Corundum (cleaved fragment)             | 4411b     |  |                            |
| Rutile                                  | 4511a     | TiO <sub>2</sub>   |                            |
| Rutile (crystals in marble)             | 4511b     |  |                            |
| Uraninite (in pegmatite)                | 5.1.2.1a  |  |                            |
| Uraninite (pitchblende)                 | 5.1.2.1b  |  |                            |
| <b>Hydroxides</b>                       |           |  |                            |
| Goethite                                | 7122      |  |                            |
| Bauxite*                                | 623       | Not a mineral – a mixture of diaspore, gibbsite and boehmite |                            |
| Brucite (foliated, in marble)           | 6.1.1.1a  | Mg(OH) <sub>2</sub>  |                            |
| Brucite                                 | 6.1.1.1b  |  |                            |
| <b>Halides</b>                          |           |  |                            |
| Halite                                  | 9.1.1.1   | NaCl   | Cubic, $4/m\bar{3}2/m$     |
| Sylvite                                 | 9.1.1.2   | KCl  | Cubic, $4/m\bar{3}2/m$     |
| Fluorite (green)                        | 9.2.1a    | CaF <sub>2</sub>   | Cubic, $4/m\bar{3}2/m$     |
| Fluorite (purple or grayish)            | 9.2.1b    |  |                            |
| <b>Carbonates</b>                       |           |  |                            |
| Calcite (var. chalk)                    | 14.1.1.1a | CaCO <sub>3</sub>  | Hexagonal (trigonal)       |
| Calcite (var. dogtooth spar)            | 14.1.1.1b |  |                            |
| Calcite (rhombohedral cleaved fragment) | 14.1.1.1c |  |                            |
| Dolomite (granular, in marble)          | 14.2.1.1a | CaMg(CO <sub>3</sub> ) <sub>2</sub>                          | Hexagonal (trigonal)       |

| MINERAL                      | ID#       | FORMULA   | CRYSTAL SYSTEM/POINT GROUP     |
|------------------------------|-----------|---|--------------------------------|
| Dolomite (crystals)          | 14.2.1.1b |   |                                |
| Rhodocrosite                 | 14.1.1.4  | MnCO <sub>3</sub>   | Hexagonal (trigonal)           |
| Siderite                     | 14.1.1.3a | FeCO <sub>3</sub>   | Hexagonal (trigonal)           |
| Magnesite (granular)         | 14.1.1.2  | MgCO <sub>3</sub>   | Hexagonal (trigonal)           |
| Malachite                    | 16.1.6    | Copper carbonate hydrate                                  |                                |
| <b>Sulphates</b>             |           |   |                                |
| Barite                       | 28.3.1.1  | BaSO <sub>4</sub>   | Orthorhombic, <i>2/m2/m2/m</i> |
| Anhydrite (cleaved fragment) | 28.3.2a   | CaSO <sub>4</sub>   |                                |
| Gypsum (var. selenite)       | 29.6.3a   | CaSO <sub>4</sub> •2H <sub>2</sub> O                      | Monoclinic, <i>2/m</i>         |
| Gypsum (granular)            | 29.6.3b   |   |                                |
| <b>Phosphates</b>            |           |   |                                |
| Apatite (crystal)            | 41.7.1.1a | Ca <sub>5</sub> (PO <sub>4</sub> ) <sub>3</sub> (F,Cl,OH) | Hexagonal, <i>6/m</i>          |
| Apatite (green, in calcite)  | 41.7.1.1b |   |                                |
| Apatite (var. collophane)    | 41.7.1.1c |   |                                |

## SILICATES

| MINERAL                      | ID#        | FORMULA                             | CRYSTAL SYSTEM/POINT GROUP                            |
|------------------------------|------------|-------------------------------------|---|
| <b>Silica group</b>          |            |                                     |   |
| Quartz ( $\alpha$ , crystal) | 56.1a.1.1a | SiO <sub>2</sub>                    | High quartz: trigonal, 32, low quartz: hexagonal, 622 |
| Quartz (var. amethyst)       | 56.1a.1.1b |                                     |   |
| Quartz (var. smoky)          | 56.1a.1.1c |                                     |   |
| Quartz (var. rose)           | 56.1a.1.1d |                                     |   |
| Quartz (var. jasper)         | 56.1a.1.1f |                                     |   |
| Quartz (var. flint)          | 56.1a.1.1g |                                     |   |
| Quartz (var. chert)          | 56.1a.1.1h |                                     |   |
| Opal                         | 56.1a.3.3  | SiO <sub>2</sub> •nH <sub>2</sub> O | amorphous   |
| <b>Feldspar group</b>        |            |                                     |   |

| MINERAL                                | ID#        | FORMULA   | CRYSTAL SYSTEM/POINT GROUP  |
|--|------------|---|---|
| Albite (cleaved fragment)              | 56.4a.1.1  | NaAlSi <sub>3</sub> O <sub>8</sub>  | Triclinic, $\bar{1}$  |
| Labradorite (cleaved fragment)         | 56.4a.1.4  | CaAl <sub>2</sub> Si <sub>2</sub> O <sub>8</sub>                          | Triclinic, $\bar{1}$  |
| Microcline (gray, perthitic)           | 56.4b.1.1a | KAISi <sub>3</sub> O <sub>8</sub>   | Triclinic, $\bar{1}$ (orthoclase and sanidine: monoclinic, <i>2/m</i> ) |
| Microcline (pink, perthitic)           | 56.4b.1.1b |   |   |
| Microcline (var. amazonite, perthitic) | 56.4b.1.1c |   |   |
| <b>Feldspathoid group</b>              |            |   |   |
| Leucite (in volcanic rock)             | 56.3.1.2   |   |   |
| Nepheline (in syenite)                 | 56.2.1.1   |   |   |
| Cancrinite (yellow, in rock)           | 56.6.1.1   |   |   |
| Sodalite (blue)                        | 56.7.1.1   |   |   |
| <b>Zeolite group</b>                   |            |   |   |
| Heulandite                             | 56.13.2.1  |   |   |
| Stilbite                               | 56.13.2.2  |   |   |
| Chabazite                              | 56.13.5.1  |   |   |
| <b>Other tectosilicates</b>            |            |   |   |
| Analcime                               | 56.3.1.1   |   |   |
| Scapolite (crystal)                    | 56.9.1b    |   |   |
| Scapolite (cleaved fragment)           | 56.9.1c    |   |   |
| <b>Phyllosilicates</b>                 |            |   |   |
| Kaolinite                              | 55.5j.1.1  | Al <sub>2</sub> Si <sub>2</sub> O <sub>5</sub> (OH) <sub>4</sub>          |   |
| Montmorillonite (smectite gr.)         | 55.4e.1.1  |   |   |
| Talc (foliated)                        | 55.3.2.1a  | Mg <sub>3</sub> Si <sub>4</sub> O <sub>10</sub> (OH) <sub>2</sub>         |   |
| Talc (fine-grained, in soapstone)      | 55.3.2.1b  |   |   |
| Pyrophyllite (radiating crystals)      | 55.3.1.1.a | Al <sub>2</sub> Si <sub>4</sub> O <sub>10</sub> (OH) <sub>2</sub>         |   |
| Muscovite (cleavage sheet)             | 55.4a.1.1a | KAl <sub>3</sub> Si <sub>3</sub> O <sub>10</sub> (OH) <sub>2</sub>        | Monoclinic, <i>2/m</i>  |
| Muscovite (in pegmatite)               | 55.4a.1.1b |   |   |
| Glauconite (in sandstone)              | 55.4a.3.1  |   |   |
| Biotite (cleavage sheet)               | 55.4a.4.1a | K(Mg,Fe) <sub>3</sub> AlSi <sub>3</sub> O <sub>10</sub> (OH) <sub>2</sub> | Monoclinic, <i>2/m</i>  |

| MINERAL                                      | ID#        | FORMULA   | CRYSTAL SYSTEM/POINT GROUP |
|--|------------|---|----------------------------|
| Biotite (in syenite)                         | 55.4a.4.1b |   |                            |
| Phlogopite (cleavage sheet)                  | 55.4a.4.3a | $\text{KMg}_3\text{AlSi}_3\text{O}_{10}(\text{OH})_2$                 | Monoclinic, $2/m$          |
| Phlogopite (with calcite)                    | 55.4a.4.3b |   |                            |
| Lepidolite (in pegmatite)                    | 55.4a.4.4  | $\text{K}(\text{Li,Al})_{2-3}\text{AlSi}_3\text{O}_{10}(\text{OH})_2$ | Monoclinic, $2/m$          |
| Vermiculite (cleaved sheet)                  | 55.4g.1.1  |   |                            |
| Chlorite (in schist)                         | 55.5a.1    |   |                            |
| Chrysotile, serpentine gr.                   | 55.7b.1.1a | $\text{Mg}_3\text{Si}_2\text{O}_5(\text{OH})_2$                       | Monoclinic, $2/m$          |
| Chrysotile, serpentine gr. (asbestiform)     | 55.7b.1.1b |   |                            |
| Prehnite                                     | 52.8.5     |   |                            |
| <b>Amphibole group (all clin amphiboles)</b> |            |   |                            |
| Grunerite (in schist)                        | 54.2b.1.3  |   | Monoclinic, $2/m$          |
| Tremolite (crystal)                          | 54.2b.2.1  |   | Monoclinic, $2/m$          |
| Actinolite (in radiating crystals)           | 54.2b.2.2b |   | Monoclinic, $2/m$          |
| Hornblende (cleaved fragment)                | 54.2b.3.2a |   | Monoclinic, $2/m$          |
| Hornblende (crystal)                         | 54.2b.3.2b |   |                            |
| Hornblende (phenocrysts in andesite)         | 54.2b.3.2c |   |                            |
| Hornblende (from a calc-silicate rock)       | 54.2b.3.2d |   |                            |
| Riebeckite-glaucophane (in schist)           | 54.2b.4.1  |   | Monoclinic, $2/m$          |
| <b>Pyroxene group</b>                        |            |   |                            |
| <i>Orthopyroxenes:</i>                       |            |   |                            |
| Enstatite-ferrosilite (metamorphic rock)     | 54.1a.1.1  | $\text{MgSiO}_3\text{-FeSiO}_3$                                       | Orthorhombic, $2/m2/m2/m$  |
| Enstatite-ferrosilite (cleaved fragment)     | 54.1a.1.2a |   |                            |
| Enstatite-ferrosilite (in granulite)         | 54.1a.1.2b |   |                            |
| <i>Clinopyroxenes:</i>                       |            |   |                            |
| Augite (cleaved fragment)                    | 54.1b.4.1a | see textbook for composition  | Monoclinic, $2/m$          |
| Augite (crystal)                             | 54.1b.4.1b |   |                            |
| Augite (in gabbro dyke)                      | 54.1b.4.1c |   |                            |
| Augite (in calc-silicate rock)               | 54.1b.4.1d |   |                            |
| Diopside (crystal)                           | 54.1b.3.1a | $\text{CaMgSi}_2\text{O}_6$   | Monoclinic, $2/m$          |
| Hedenbergite (not in samples)                |            | $\text{CaFeSi}_2\text{O}_6$   | Monoclinic, $2/m$          |

| MINERAL                                    | ID#       | FORMULA  | CRYSTAL SYSTEM/POINT GROUP           |
|--|-----------|--|--------------------------------------|
| Aegirine (not in samples)                  |           | $\text{NaFe}^{3+}\text{Si}_2\text{O}_6$            | Monoclinic, $2/m$                    |
| Spodumene (in pegmatite)                   | 54.1c.1.1 | $\text{LiAlSi}_2\text{O}_6$                        | Monoclinic, $2/m$                    |
| <b>Pyroxenoids</b>                         |           |  |                                      |
| Rhodonite                                  | 54.3.2.1a | $\text{MnSiO}_3$                                   |                                      |
| Wollastonite                               | 54.3.3.1  | $\text{CaSiO}_3$                                   |                                      |
| Pectolite                                  | 54.4.1.1  |  |                                      |
| <b>Cyclosilicates</b>                      |           |  |                                      |
| Beryl                                      | 53c.1.1.1 | $\text{Be}_3\text{Al}_2(\text{Si}_6\text{O}_{18})$ | Hexagonal, $6/m2/m2/m$               |
| Cordierite (in a high-grade gneiss)        | 53c.1.1.2 |  |                                      |
| Schorl, tourmaline gr.                     | 53c.2.1.1 | Fe tourmaline                                      | Hexagonal (trigonal), $3m$           |
| Dravite, tourmaline gr. (in marble)        | 53c.2.1.2 | Mg tourmaline                                      | Hexagonal (trigonal), $3m$           |
| Elbaite, tourmaline gr. (with lepidolite)  | 53c.2.1.3 | Li-Na tourmaline                                   | Hexagonal (trigonal), $3m$           |
| <b>Sorosilicates</b>                       |           |  |                                      |
| Epidote (granular)                         | 52.7.1.2  |  |                                      |
| Allanite (probably metamict)               | 52.7.2.1  |  |                                      |
| Vesuvianite                                | 52.7.4.3a |  | Tetragonal, $4/m2/m2/m$              |
| Vesuvianite (crystal)                      | 52.7.4.3b |  |                                      |
| Chloritoid (in schist)                     | 51.15.1   |  |                                      |
| <b>Orthosilicates</b>                      |           |  |                                      |
| Forsterite, olivine gr.                    | 51.2.1.1  | $\text{Mg}_2\text{SiO}_4$                          | Orthorhombic, $2/m2/m2/m$            |
| Forsterite, olivine gr. (in dunite)        | 51.2.1.2a |  |                                      |
| Olivine gr. (in basalt)                    | 51.2.1.2b | $(\text{Mg,Fe})_2\text{SiO}_4$                     | Orthorhombic, $2/m2/m2/m$            |
| <i>Garnet group:</i>                       |           |  |                                      |
| Almandine, garnet gr. (in schist)          | 51.3.1.2  | $\text{Fe}_3\text{Al}_2\text{Si}_3\text{O}_{12}$   | Cubic, $4/m\bar{3}2/m$ (all garnets) |
| Grossular, garnet gr. (calc-silicate rock) | 51.3.2.1  | $\text{Ca}_3\text{Al}_2\text{Si}_3\text{O}_{12}$   |                                      |
| Andradite, garnet gr., (from pegmatite)    | 51.3.2.2  | $\text{Ca}_3\text{Fe}_2\text{Si}_3\text{O}_{12}$   |                                      |
| Pyrope (not in samples)                    |           | $\text{Mg}_3\text{Al}_2\text{Si}_3\text{O}_{12}$   |                                      |

| MINERAL  | ID#       | FORMULA              | CRYSTAL SYSTEM/POINT GROUP |
|--|-----------|----------------------|----------------------------|
| Spessartine (not in samples)                     |           | $Mn_3Al_2Si_3O_{12}$ |                            |
| Uvarovite (not in samples)                       |           | $Ca_3Cr_2Si_3O_{12}$ |                            |
| Zircon   | 51.4.1.1  | $ZrSiO_4$            | Tetragonal, $4/m2/m2/m$    |
| Chondrodite, humite gr. (in marble)              | 51.5.1.3  |                      |                            |
| Topaz (showing cleavage)                         | 51.4.5.1a |                      |                            |
| Topaz (cleaved fragments)                        | 51.4.5.1b |                      |                            |
| Titanite (showing parting)                       | 51.7.1.1a | $CaTiSiO_5$          |                            |
| Titanite (in calc-silicate rock)                 | 51.7.1.1b |                      |                            |
| Staurolite (twinned crystal)                     | 51.4.5.2a |                      |                            |
| Staurolite (in schist)                           | 51.4.5.2b |                      |                            |
| <i>Al<sub>2</sub>SiO<sub>5</sub> Polymorphs:</i> |           |                      |                            |
| Sillimanite (in gneiss)                          | 51.4.4.1  | $Al_2SiO_5$          | Orthorhombic, $2/m2/m2/m$  |
| Andalusite (var. chiastolite)                    | 51.4.4.3a | $Al_2SiO_5$          | Orthorhombic, $2/m2/m2/m$  |
| Andalusite (var. chiastolite, in schist)         | 51.4.4.3b |                      |                            |
| Kyanite (blue, bladed)                           | 51.4.4.4a | $Al_2SiO_5$          | Triclinic, $\bar{1}$       |
| Kyanite (in schist or gneiss)                    | 51.4.4.4b |                      |                            |