GARNET & ILMENITE GEOCHEMICAL COMPUTER PROGRAMS FOR EXPLORATION FOR DIAMONDS.

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GARNET.

The question of reliable evaluation of chemical composition of the most important kimberlite indicator mineral - garnet - for confident diamond exploration is among unsolved problems of diamond geology due to the presence of high amount of orange-series metamorphic garnets in soil/till samples, sometimes with high sodium content (/0.07 wt. %).

Using almost total chemical composition and based on natural statistical distribution of currently about 45.000 analyses of individual garnet grains from:
America (Canada, Brazil, Chile, Uruguay, U.S.A., Venezuela)
Africa (Angola, Botswana, Congo, Gabon, Lesotho, South Africa, Swaziland, Tanzania, Zambia, Zimbabwe)
Europe (Czech Republic, Finland, Germany, Greenland, Ukraine)
Asia (China, India, Kazakhstan, Nepal, Russia) and *Australia*,
the Garnet Diagram received (Excel based computer program) has distinctive linear shape and displays two main subparallel fields: ***kimberlitic*** (in terms of possibility of the presence of diamond in thermodynamically *stable* [technically potentially minable] condition) and ***non-kimberlitic*** (where diamond could be represented just as a *metastable* phase). The gap between both fields is quite clear and it allows to use this Program for practical identification of the source of *each garnet grain.*

Kimberlitic field looks like a mixture of pyropes (PYR – without sodium, according to the most popular point of view, not supported by author) and eclogitic garnets (ECL – with some amount of sodium) with clear concentration of purple PYR in the right bottom and orange ECL – in the top left corner of the Diagram, however, without any indications of geochemical border between them.

It is necessary to note that about 80 % of *non-kimberlitic* garnets, which were included in present database, in most cases mineralogically were identical to eclogitic garnets of kimberlites (ECL), but they had been confirmed by microprobe laboratory as an eclogitic garnets just in general meaning. Only using this Program it became possible to separate metamorphic garnets of crustal eclogites from ECL.

Garnet Inclusions in Diamonds (**GID**: 537 grains) create three separated sub-fields (three sources of diamonds?) within kimberlitic field: one peridotitic (GID-3 - in the right bottom of the Diagram) and two eclogitic – in the opposite side. The number of eclogitic sub-fields might reflect the existence of two genetically different types of eclogites: metamorphic (GID-2) and magmatic (GID-1).
GID-1 is a small, isometric, clear separated group of garnets.
GID-2 is a largest diamond sub-field, perhaps, because these rocks are the most widespread within kimberlite related formations. This sub-field contains group of ultra-high pressure *majoritic* garnets at its NE border, and group of garnets from diamondiferous gneisses from Erzgebirge, Saxony, Germany and from Kokchetav massif, Kazakhstan - near its SW border, which can indicate the increasing of p-T conditions in diagonal direction from SW to NE of the Diagram.
All three GID sub-fields **do not** coincide with HSG maximum, and just 46 % of inclusions in diamonds are equal or exceed the 0.07 wt. % of sodium threshold.

The **High-Sodium Garnets** area (**HSG**) is very extensive (>3.000 grains) and extends into both main fields with strong local concentration in the middle of kimberlitic field. Statistically, about 9 % of all garnets have Na_2O/0.07 wt. %, and 4 % of HSG belong to non-kimberlitic field. Maximum of concentration of HSG coincides with border between red and orange garnets, and also with the same maximum of CPM.

Cr-poor megacrysts (**CPM**: 392 grains) created local maximum between diamond fields GID-2 and GID-3, or generally between PYR (red) and ECL (orange) regions. Very few GID match this area.

ILMENITE.

The Ilmenite Program is based on currently about 25.000 of individual analyses. The Ilmenite Diagram consists of "Kimberlitic Field", "Non-Kimberlitic Field" and "Kimberlitic Oxides". Kimberlitic field contains clear separated sub-field of "Diamondiferous kimberlites". Kimberlitic oxides are mostly represented by chromites. That is why it is possible to use this Program for separation of non-kimberlitic chromites with high chromium content (so-called "Kurung-type" by Afanasiev V.P. et al) from kimberlitic chromites of diamond association.

SOME CONCLUSIONS.

Proposed Programs can aid in:

- Sorting of garnet and ilmenite grains from soil/till samples to create realistic exploration maps without their contamination by metamorphic minerals.
- Control of source of garnet-bearing (especially eclogitic) xenoliths in kimberlite pipes: crustal or mantle?
- Preliminary evaluation of kimberlite diamond grade without its artificial exaggeration, which makes difference between calculated diamond grade after exploration drilling (which is mostly higher) and real grade after mining (mostly lower).
- Combined evaluation of territories: area potential minus diamond potential of discovered kimberlites = potential of undiscovered kimberlites.
- Outlining of the borders between kimberlite clusters: the location of PYR-image within GID-3 corresponds with kimberlite pipe location on the land.
- Planning the future exploration based on "geochemical-geographical" relations between pyropes composition and kimberlite pipes location within kimberlite clusters.
- Also: there is no reason to use 0.07 % of sodium as a threshold for outlining of diamond association of garnets.
- No reason to create artificial borders (2 % or 0.5 % of chromium, or by presence or absence of any amount of sodium) between PYR and ECL. A lot of purple pyropes have some amount of sodium. Statistically, just 4.2 % of *all* garnets have sodium content less than 0.01 %, however, the amount of purple garnets is obviously much higher. On the other hand many of eclogitic garnets have no sodium at all and just low chromium. A lot of non-kimberlitic garnets have significant amount of sodium (0.07 % and higher).

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