Tertiary-Quaternary Gold-Bearing Lateritic Profiles In The Kahama And Rwamagaza Belts, Nw Tanzania: A Stratigraphical, Geochemical And Environmental Study

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Abstract. The studied areas lie within the gold-bearing Nyanzian greenstone belt of North Western Tanzania. The prime objectives of the study were to establish the stratigraphy and geomorphological setting of the areas; to give an insight of gold (Au) and other associated elements and mineral distribution characteristics in the weathering profiles. We also tried to use Quaternary sediments for an environmental health (mercury pollution due to gold recovery processes) appraisal. This was accomplished by various laboratory and computer generated techniques such as geochemical analysis, clay mineralogical analysis, scanning electron microscope (SEM) analysis, polarizing microscopic studies and by the use of various statistical packages and other computer programs.

A combination of stratigraphical and geomorphological investigations made possible the recognition of three main land surfaces at specific altitudes (except where they have been modified by the Cenozoic uplift). These land-surfaces are (1) the sub-Miocene land surface (at about 1250m altitude), this is characterized by somewhat thick concrete crust covering deeply decomposed bedrock consisting of red and mottled clays. (2) the end-Tertiary land-surface (at about between 1250 - 1170m altitude), this has a relatively thin lateritic crust. Both levels of the lateritic ferricrete are of economic interest since eluvial gold placer deposits of unknown potential are thought to be present locally beneath them, particularly in the vicinity of gold-bearing Nyanzian greenstones. The latosol and humic horizon on top of these land surfaces indicates a somewhat tropical humid to equatorial forest climate responsible for their formation during the Quaternary, while the stone line reflects a relatively dryer phase in between them. Most probably the stone layer reflect the cold/drought maximum of about 20,000 years BP or the Younger Dryas of about 11,000 years BP, both of which denotes the synchronous and enhanced desertification all over the globe. (3) the Plio-Pleistocene proto-Lake Victoria basin (at about 1170m altitude), is characterized by lacustrine beach flats, which are essentially wave-cut platform of the former lake strewn with waterworn pebbles of the local bedrock.

Gold distribution is somewhat lithologically controlled, with latosols being poor in gold while nodular and mottled clay zones are somewhat enriched with gold. Most probably gold concentration in these horizons is a result of weathering of colluvial materials from quartz veins that are known to host primary gold. There is a very good correlation between Au and Pb at Buziba, in fact the correlation is significant even at 0.01 level of confidence. This is in line with the fact that Pb (together with As, Sb and W) is a pathfinder for Au in soils.

The statistical treatment (factor analysis) of geochemical data and synthesis of mineralogical results proved that besides the environmental availability (bedrock related) of trace elements, the actual content of trace elements in laterite is to large extent controlled by the mineral phase composition of the weathered mantle. The most striking example of this mineralogical control is the association

of goethite with REE, Ba, Y, Mn, Ce, U, Cu, V, Th, Pb and Zn, confirmed indirectly through their affinity to high organic matter content. Considering that goethite formation is greatly enhanced by the presence of organic matter, it is postulated that formation and breaking of the organometallic complexes is to large extent the process controlling the dispersion of patterns of the aforementioned trace elements.

REE behaviour in weathering profiles reveals a less pronounced LREE enrichment relative to HREE while significant positive Ce-anomalies have been encountered in Mn-Fe enriched zones, especially in indurated laterites and in the mottled zone.

The study of the geochemical imprint of the substratum in gold-bearing lateritic soils, based on trace element distribution pattern, enabled the assessment of the character of the bedrocks and established the boundaries between them. The simple statistical tools like cumulative frequency graphs applied to the elements like Mn and Nb gave good results in partitioning of the gathered samples between the two populations i.e. laterites developed on the schists and laterites developed on tuffs. Mineralogical analysis on hard nodular iron crust and top pebbly soil provides a partitioning mechanism of studied profiles between two land surfaces on which they are developed. In the Nyangomango profile which develops on mid-Tertiary land surface, the nodular horizon was formed under a more humid tropical climate which made formation of gibbsite possible. On the other hand, the top pebbly soil horizon at Iyenze profile, which develops on end-Tertiary land surface was formed during a somewhat tropical, short dry season (wet savanna) culminating in formation of goethite.

Somewhat severe mercury contamination has been found in the Bulyanhulu river, kahama greenstone belt, that supports the fishing industry and serves as the major source of domestic water; values as high as 23.6 ng/g methyl mercury have been revealed by this study. The values for the Rwamagaza greenstone belt are relatively low. Dark-coloured sediments (apparently from areas with little or no gold washing activities) have low total mercury values, and shows very good correlation between total mercury values and corresponding organic matter contents as well as the fine grain fraction. Samples from areas active in gold mining (various sample clours from 2.5YR 2.5/4 dark reddish brown through 10YR 3/1 very dark gray) shows little or no correlation between total mercury and organic matter content. There is a strong correlation between methyl mercury and organic matter content in the representative samples analysed.