

0793843

XIII International Geochemical Exploration Symposium

RIO 89 Brazilian Geochemical Congress

USP-IGC
551.90961
Q749
23
1989
v. 2

11002

MONOGRAFIAS

ABSTRACTS : 13. INTERNATIONAL GEOCHEMICAL EXPLORATION SYMPOSIUM : 2. BRAZILIAN GEOC



Abstracts



*Rio de Janeiro, Brazil
October 1-6, 1989*



Este Volume, como as demais publicações do XIII IGES e do II CBGq, teve a sua edição coordenada pelo Serviço de Edições Técnicas - SETEC, da Companhia de Pesquisa de Recursos Minerais - CPRM, com o apoio do Departamento Nacional da Produção Mineral - DNPM

A sua impressão foi possível graças ao apoio dos Patrocinadores desse evento.

CONTROL OF THE DISTRIBUTION OF Mn, Co, Zn, Cr, Zr, Ti AND REE DURING THE EVOLUTION OF LATERITIC WEATHERING COVERS ABOVE ULTRAMAFIC ROCK COMPLEXES

Marker, A.

Instituto de Geociências, UFBA, Salvador, Brazil

Friedrich, G.

Institut für Mineralogie & Lagerstättenlehre, RWTH Aachen, FRG

Carvalho, A.

Melfi, A.

Instituto de Geociências, USP, São Paulo, Brazil

Lateritic weathering covers above ultramafic rock complexes can be subdivided into autochthonous and semiautochthonous weathering horizons. The latter are constituted of a mixture of (a) autochthonous, Fe-Cr-rich limonitic material derived from ultramafic rocks and (b) Al-Si-Ti-Zr-rich weathering material derived from spatially associated sialic rocks (MARKER, 1988). Although generally neglected and often difficult to identify, such polygenetic weathering covers are abundant above ultramafic rocks worldwide, as recently reported by SCHELLMANN (1989). They can be expected above various types of bedrock and may be responsible for the occurrence of highly unusual element distribution patterns in the lateritic environment.

Serpentinized dunites and peridotites of Las Buenas and Olympic Mines in ophiolitic belts of the Philippines and serpentinized dunites of the Jacupiranga Alkaline Complex in Brazil are overlain by Fe-rich limonitic laterites of the latosol type, grading towards the bottom into a saprolite zone. Semiautochthonous laterite horizons, which constitute the top portion of these laterites, generally accumulate in morphological depressions, which in Brazil and the Philippines are related to the formation of peridotite karst.

Profile development and element distribution are controlled by (a) autochthonous weathering processes, (b) formation parameters of the semiautochthonous laterite and its (c) podsollic or lateritic superimposition.

In the upper saprolite, Cr, Mn, Co and Zn are subject to mobilization and depletion (figure). The considerable depletion of silicate-bound Cr during initial weathering is of high importance, since this element is often used as an internal standard for mass balance calculations. In this study, mass balances have been calculated by using unweathered chrome-spinels as internal reference. While Cr remains depleted throughout the profile, Co and Zn are newly enriched in the zone of Ni-silicate formation in the upper saprolite. Mn and Co show distinct enrichment in the autochthonous lower limonitic zone, where they occur in the form of mon-stoichiometric manganese oxides like asbolite. These mineral phases act as sinks for Ce and other REEs which may anomalously be concentrated in this zone. The enrichment of Mn, Zn and Co results from their mobilization in upper profile parts and subsequent

downward migration. Since mass balance calculations indicate Mn and Co excess, lateral supply and mobilization from already eroded profile portions are likely (GOLIGHTLY, 1981).

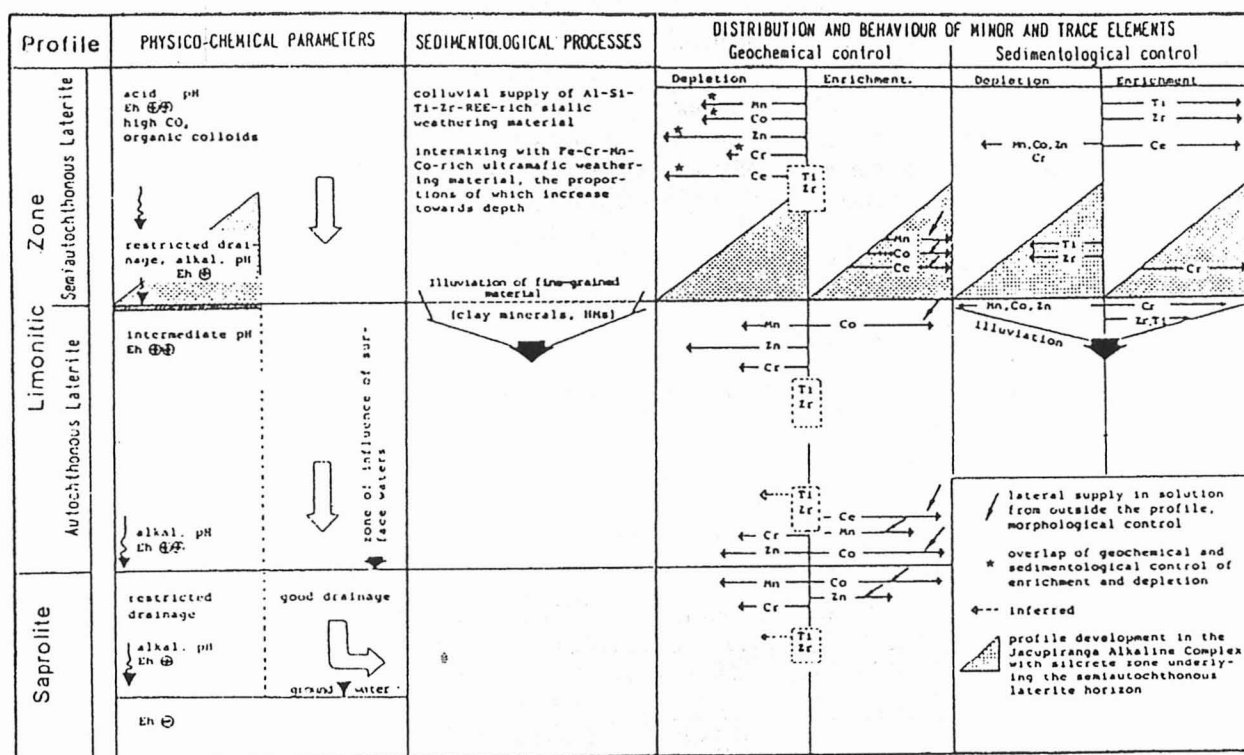
In the semiautochthonous laterite horizon, the low contents of "ultramafic" elements like Cr, Mn, Co and Zn are not only caused by the above mentioned depletion. In the first place they result from dilution by "sialic" Al-Si-Ti-Zr-REE-rich weathering material, which has been supplied by colluvial transport. In the semi-autochthonous laterite, Zr- and Ti-contents characteristically increase towards the profile top. Both elements show enrichment factors relative to the source rock of $> > 10$, indicating absolute mechanical supply from sialic lithologies rather than in-situ lateritization, as also confirmed by SCHELLMANN (1989). The upward increase of these elements coincides well with increasing contents of zircon, ilmenite, rutile and Ti-magnetite in the heavy mineral (HM) fraction and of Al and Si in the Bulk weathering material, while the chrome-spinel contents increase towards the bottom, thus controlling the distribution of Cr in the semiautochthonous laterite. This fact is explained by increasing supply of sialic material during later stages of the formation of the semiautochthonous laterite. Sialic material is derived from veins and dikes of gabbroic and leucocrate composition, which are abundant in the ultramafic. Less intensive weathering and desintegration of sialic rocks in comparison to ultramafics results in later erosion and deposition of their weathering products in the semiautochthonous laterite (Marker, 1988). While Ti and Zr in the heavy minerals remain essentially immobile in this horizon, Ce and other REEs become mobilized during lateritic/podsolic superposition of the semiautochthonous laterite and migrate downward into the autochthonous laterite bound to Mn-colloids. Under rising pH-conditions, they precipitate together with Mn-oxides. The enrichment of Ce and other REEs is very significant in the area of the Jacupiranga Alkaline Complex, where secondary Mn-phases may contain more than 16 wt-% Ce. Besides Ce, the heavy REEs Yb and Lu are slightly enriched in relation to the intermediate REEs and thus show a distinct fractionation in relation to alkaline and peralkaline rocks, which constitute the source for the REE.

Drainage and geomorphology control the spatial distribution of the elements in the weathering cover. Due to higher mobility, Mn, Co and REE migrate along the topographical gradient within the basin structures and accumulate in the basin floors, where drainage is temporarily impeded and concentration of the solutions is high. In Jacupiranga, zones of restricted drainage above silcrete layers, which serve as geochemical barriers for downward migrating solutions, result in enhanced formation of Mn-oxides which trap REE. Thus, as the example of the Jacupiranga Alkaline Complex shows, REE anomalies in laterites can be expected in geological settings, where Mn-rich ultramafic and REE-rich alkaline rocks are intimately associated and thick semi-autochthonous laterites with high allochthonous sialic

proportions have developed. Furthermore, morphological traps like peridotite karst structures favour accumulation of REE, Mn and Co.

REFERENCES

- GOLIGHTLY, J.P. 1981. Nickeliferous laterite deposits. Econ. Geol., 75th Annivers. Vol., 710-735.
- MARKER, A. 1988. Lteritische Vermittlungsdecken über ultramafischen Gesteinskomplexen in Brasilien und den Philippinen. Ph. D. thesis (unpubl.), Institute of Mineralogy, RWTH Aachen, 319 pp.
- SCHELLMANN, W. 1989. Allochthonous surface alteration of Ni-laterites - Chem. Geol., 74, 35-364



Distribution and behaviour of Mn, Co, Cr, Zn, Ti, Zr and Ce in lateritic weathering covers overlying ultramafic rock complexes in function of geochemical parameters and sedimentological processes; mass balance calculation base on chrome-spinel contents as internal reference; length of arrows approximately corresponds to degree of depletion/enrichment.