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Abstracts

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STUDY OF SUPERGENIC BEHAVIOR OF NICKEL AND SOME PRACTICAL CONSEQUENCES

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Brazilian nickel resources come essentially from supergenic deposite which occur scattered throughout the country, being rarer in the northeastern region and in the south, below 25° latitude. They are mainly associated with Archean mafic-ultramafic massifs of large dimensions such as, Niquelândia and Barro Alto, Cretaceous ultramafic-alkaline complexes, such as, Santa Fé and Jacupiranga and with small ultramafic Alpine-type Precambrian bodies, for instance, Morro do Níquel. Most of them occur in central Brazil, under a tropical climate with contrasting seasons.

The investigations carried out in many of these deposits (Trescases & Oliveira, 1978, 1981; Oliveira & Trescases, 1980, 1982; Oliveira et al., 1988) allowed the evaluation of the role of petrographic and morphogenetic conditions in their genesis and led to the following conclusions (Melfi et al., 1979; Oliveira et al., 1989):

- the deposits are mainly derived from lateritic alteration of dunites and peridotites, but can also be found associated to pyroxenites (Niquelândia);

- the degree of lateritisation was moderate, leadind to rather shallow profiles where the silicated ore prevails over the oxidised one;

- the most important ore minerals are Ni-serpentine and Ni-smectite; garnierites which, despite the very high Ni contents, are scarce;

- the deposits can be correlated to two erosional cycles, namely, Sul Americano (Lower Tertiary) and Velhas (Upper Tertiary); accordingly, they can be found either in highlands and in lowlands;

- highland deposits are covered by a silcrete layer; in lowland deposits, a higher degree of lateritisation is observed.

The nickel lateritic profiles are derived from rocks formed essentially of olivine, serpentine and pyroxene. In the earlier stages of the alteration process, olivine is gradually hydrolised, releasing Mg, Si and Ni, which are precipitated, either as amorphous products filling the void spaces between the fibers of serpentine or as neoformed garnierite in the cracks of the altered rocks. As the alteration proceeds, serpentine is destroyed, leaving behind a Ni-goethitic residue. The garnierite is no more stable and is dissolved as well. The pyroxenes change initially into Mg-Ni trioctahedral smectites, later transformed into Fe-Al dioctahedral varieties, and finally into kaolinite and Fe-hydroxites (Colin et al.,1989).

The release of nickel, due to the destabilisation of either the neoformed products (smectite and garnierite) or the inherited parent minerals (serpentine), leads to its redistribution in the phylossilicates at the bottom of peridotitic profiles and downslope in the topographic sequence.

Pyroxenitic profiles, due to their low original nickel content, are not mineralized, except when situated at footslope of peridotitic elevations. In this case, solutions released from the upper parts percolate the pyroxenitic profiles providing Ni for the formation of trioctahedral smectites.

The history of the weathering blankets developed on ultramafic rocks in Brazil began in the Lower Tertiary, on the lately-formed Sul Americana Planation Surface. At that time, two different alteration mechanisms were active:

- silicification at the bottom of the profiles, probably related to semi-arid climatic episodes;
- lateritisation of these profiles promoting nickel concentration.

In the Upper Tertiary, a new erosion cycle named Velhas was established, dismantling the Sul Americana surface and originating a new one at lower altitudes. The alteration profiles developed on the older surface were eroded down to the silicified horizon, which behaved as a protection against the general levelling. Products derived from these ancient profiles are found today mixed with the upper levels of the lateritic profiles developed on the Velhas surface.

The lateritic weathering has gone on up to the present day both in the highlands under the silicified layer and in the lowlands. This process has occurred together with a lateral migration of nickel. As a consequence, the more eroded the Sul Americana surface, the more intense have been the migration processes, being nearly absent where the Sul Americana surface has been well preserved.

The results achieved so far have some interesting consequences for the prospection of new deposits and give important information for planning mineral dressing techniques.

The first point to be taken into consideration is that lateritic nickel deposits must be prospected preferentially in tropical regions where the Sul Americana surface is at least partially preserved, as in central Brazil, in Amazonia and in some points of the Brazilian eastern region. The silcrete layer impregnated by garnierite on the top of the elevations can be a good hint for the discovery of new deposits.

The following point to be considered refers to the fact that the Brazilian nickel lateritic ore is quite special as compared with those from other deposits in the world. Being predominantly of the silicated type, with Ni generally occupying the octahedral position in the phyllosilicates lattice, the well established mineral dressing techniques designed for more oxidised ore are no longer apllicable. New techniques must take into account the rather great difficulty in extracting nickel.

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