Mineral distribution in the Nb- and REE-rich ferruginous lateritic crust of Seis Lagos Deposits.

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INTRODUCTION
The Seis Lagos Deposit is located in the São Gabriel da Cachoeira, northeastern of Amazonas State (Figure 1A), cutting the basement rocks of the Imeri Domain - 1.81 a 1,79 Ga (Figure 1B) (ALMEIDA et al., 2011). This deposit is one of largest Nb-deposits in the world formed due to weathering of SiO2, undersaturated alkali rocks (jadeitite carbonate) (Figure 1C). It is a 5 km diameter, circular structure outcropping in the NW Amazon region constituted by an expressiv 200 meter-thick ferruginous lateritic crust. Drill hole description, petrography, chemistry and x-ray diffractometry of the lateritic crust profile has been conducted to characterize its mineral assemblage and main processes of element mobilization and accumulation.

MATERIALS AND METHODS
The drill hole nº 1 from Seis Lagos Project (VIEGAS FILHO & BOROW, 1976) was used to study the mineralogy of the ferruginous lateritic crust of the Seis Lagos Deposit. The minerals composition were determined by using: (1) Olympus optical microscope with natural and reflected light; (2) PANalytical X-ray diffractometer of XPERT PRO diffractometer model with copper anode and 40 kV and 40 mA 5° to 70° scanned angle and step of 0.02° from Lamin-MA da SUREG-MA/CPRM; and (3) Scanning Electron Microscope FEI model L55 with energy dispersive spectrometer (EDS) (W0 8.5 mm, 20 kV a 330 - 400 pA) and backscattered electrons images (BSE) (W0 8.5 mm, 20 kV a 70 - 90 pA) from Lamin-MA da SUREG-MA/CPRM and FEI model QUANTA 450 (UnB/CPRM) 20 kV and 10 mA, both equipment with tungsten filament.

RESULTS AND DISCUSSIONS
The ferruginous lateritic profile of Seis Lagos deposit has more than 200 m of thickness (Figure 2) and can be divided into different layers according to their structures and textures, which reflects an active supergene process. The drill hole lateritic profile can be roughly divided into three parts, in the upper, intermediate and lower ones. The lower part is composed by compact ferruginous crust, the intermediate part by a manganese layer situated at 30 to 40 m below the surface, and the upper part formed by porous ferruginous layer with oolitic and brecciated textures. These variations were probably influenced by the movement of meteoric and ground water. In the upper part, the ferruginous lateritic crust shows a porous pisolithic, fragmented and mottled aspects (Figure 2) with secondary minerals as niobian rutilte, ilmenorutile, anatase, florentite and monazite, whereas in the lower part has a more compact aspect with niobian rutile and cerianite as secondary minerals. However, the goethite and hematite are the main minerals in this lateritic profile, the goethite can be massive and/or porous (Figure 3) and acicular (Figure 4). The goethite can have some Al in its composition (Figure 3), probably due the sample is close to surface. Titanium and niobium elements are well correlated with higher concentration (about 5% and 2% on average, respectively) in the upper part of the profile, while in the lower part the concentration range up to 1.5% Ti and 1.0% Nb and can have iron (Figure 5) or REE (Figure 6) in its composition. In the manganese-rich layer these both elements are lower than 0.5%. The Nb-Ti minerals like Nb-rutile and ilmenorutile are partially to highly altered and whose elements are embolized the iron minerals (Figure 7). These minerals occur as large minerals or duster of small crystals and as tiny minerals distributed in the ferruginous matrix. The anatase is also present in the uppermost part of the profile as a secondary titanium mineral, formed during supergene process. The higher concentration of rare earth elements, mainly as cerium, phosphorous and aluminum in the upper part of the lateritic profile can be related to florentite and monazite minerals (Figure 5). The former mineral is secondary ones and is filling pores, whereas the latter mineral occurs as primary mineral. The advanced alteration process leads to very porous monazite, which is also found filling pores as acicular minerals (rhabdophane?). Cerianite has been found like tiny acicular crystals aggregates filling fractures and cavities, recognized on the top of manganese-rich layer until to bottom of the drill hole.

CONCLUSIONS
The ferruginous lateritic profile of Seis Lagos deposit are mainly composed by iron minerals. However the secondary minerals show a quite variable elemental composition, some of the Nb and Ti minerals have REE and/or Fe in their composition.

REFERÊNCIAS


Figure 3 - Different upper part of Seis Lagos lateritic crust divided in its according to their structures and textures.

Figure 4 - Rounded and planar minerals shows voids filled in matrix. Nb-rich mineral filled in the matrix (s) can be seen in the yellow mineral (t) of the drill hole. The Nb-rich mineral profile shows a ferruginous crust. This mineral has more than 200 m of thickness.

Figure 5 - REE minerals from Seis Lagos lateritic crust. (a) Rhabdophane (7) at LCR-26 (6.15 m of depth) (b) Monazite and (c) Cerianite at LCR-26 (6.10 m of depth). SEM images from Lamin-MA/CPRM.

Figure 6 - Different top of Seis Lagos lateritic crust divided in its according to their structures and textures.

Figure 7 - Different top of Seis Lagos lateritic crust divided in its according to their structures and textures.