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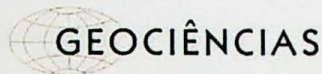
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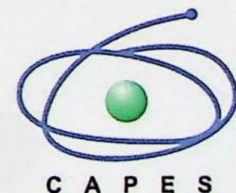
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Provenance signatures of heavy minerals in Quaternary sands of the Lower Madeira river, Brazilian Amazon

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The present study evaluated heavy minerals (transparent) signatures in sands of the Madeira and Amazon rivers, aiming to track its primary (source rocks) and secondary (among the rivers) provenance. Taking the Madeira river mouth as reference, twenty five samples of these two rivers were collected: four in the upstream Amazon river (UA), thirteen in downstream Amazon river (DA), and the remaining eight samples in the Madeira river (MR). Although the sample region is under strong chemical weathering, the general result exhibits an assembly of unstable minerals, composed mainly of augite, ferrosilite, green hornblende, and andalusite. Madeira river (MR) stands out due to its high content of andalusite (22%) and green hornblende (18%), probably related to medium- to high-grade metamorphic source rocks of the Amazon Craton. The upstream Amazon river (UA) exhibits high content of ferrosilite (27%) and augite (12%), with minor contents of brown hornblende and titanite, that suggest a basic igneous source rocks, possibly from Andean volcanic provinces. In the downstream Amazon river (DA), the appearance of andalusite (2 to 13%), virtually absent upstream, is the best proxy for the Madeira river sands. The huge variation in the content of andalusite in downstream Amazon river (DA) occurs because of the presence of a bend in the Amazon channel immediately downstream the Madeira river mouth, that pushes the Madeira plume against the cutbank. This avoids an effective mixture for up to 40 km downstream. This plume can be tracked from the Madeira river mouth in aerial photographs and satellite images.