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Baseline levels for selected elements in soils under semi-arid condition, northeast of Brazil

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Definition of baseline levels for chemical elements has become an issue of utmost importance in present days, due to the significant interaction between human activities and the environment. These baselines are understood as benchmark levels for the evaluation of further alterations eventually caused by increasing human interventions in the environment, including the soils. It is well recognized that reference values defined for soils of a certain region or condition cannot be applied to other regions or situations, inasmuch as elemental concentrations greatly vary as function of the underlying rocks and also of the weathering and pedogenic processes taking place in each particular area. In this scenario, a project is being carried out in the Potiguar Sedimentary Basin, northeast of Brazil, aiming at defining baseline levels for selected elements in soils of this Basin, with financial support of the brazilian state oil company (PETROBRAS). The basin has an outcropping area of 24,000 square kilometers and is inserted in semi-arid climate (annual average rainfall of 450 to 600 mm). It is the focus of intense oil exploration and processing, as well as of agricultural activities and urban concentrations of different sizes (from less than 10,000 to over 200,000 inhabitants). For the definition of baseline values, samples of two lithologic/pedologic representative settings of the basin (sandstone-derived soils and limestone-derived soils) were sampled in minimally disturbed sites, at two depths: 0 to 20 cm (poorly developed soils) and 35 to 55 cm (altered rock; C horizon). The first interval is considered as the soil layer most affected by possible human interferences, hence deserving special attention. The collected samples were digested by EPA 3051A method and then analyzed for 30 elements. Median and quartile values for selected elements were as

follow (0 to 20 cm depth only; median value appears after the symbol of each element; lower and upper quartile in brackets; data in mg/kg): Sandstone soil (n = 23): Al 1401 [925, 2132]; B 0.10 [0.05, 0.25]; Ba 1.2 [0.3, 9.2]; Ca 61 [40, 240]; Co 0.2 [0.1, 0.6]; Cr 6 [3, 16]; Cu 1.0 [0.6, 1.6]; Fe 4124 [1464, 10720]; Mg 36 [20, 99]; Mn 18 [13, 53]; Ni 0.5 [0.4, 1.7]; Pb 2.6 [1.7, 4.2]; Ti 13 [7, 48]; V 15 [6, 32]; Zn 4 [3, 5]; Zr 1.4 [1.0, 3.6]. Limestone soil (n = 12): Al 14421 [6302, 17063]; B 0.26 [0.19, 0.48]; Ba 46.3 [25.4, 69.1]; Ca 7133 [3334, 68906]; Co 5.2 [4.3, 6.1]; Cr 21 [13, 23]; Cu 8.7 [5.1, 11.1]; Fe 9803 [6997, 13286]; Mg 2511 [1559, 16540]; Mn 262 [1125, 304]; Ni 11.5 [5.6, 16.4]; Pb 9.5 [6.5, 14.2]; Ti 7 [6, 9]; V 21 [15, 23]; Zn 19 [14, 22]; Zr 6.2 [3.8, 7.0]. Application of the nonparametric Mann-Whitney U statistical test indicated that, except for V, concentrations of all elements are statistically different from one soil type to the other. Ongoing research in the same project encompasses other lithologic/pedologic context in the same sedimentary basin and other sampling depths, in order to include other representative soil types in the basin area and to understand the pedogenetic processes taking place there. The database to be generated will be useful for environmental assessments in the basin area and will also add to the effort of defining baseline level for different geoenvironmental settings worldwide. This is particularly true for the case of soils derived from sedimentary rocks in semi-arid regions, a condition that is not commonly addressed by those countries involved in the definition of baseline levels (reference values).