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African dust phosphorus fertilizing the Amazon and the Atlantic Ocean is derived from marine sediments and igneous rocks – no indication for Bodélé diatomite contribution

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Dust eroded from West Africa is blown across the Atlantic Ocean towards the tropics and constitutes a major external source of phosphorus (P) to the Amazon and marine surface waters. It is usually assumed that the P concentration in dust is $\sim$700 μg P g/dust based on the average concentrations in crust material. In addition, previous studies have claimed that diatomites from the Bodélé depression in Chad are a major source of P to the equatorial Atlantic Ocean and the Amazon. In this study we have utilized the oxygen isotopes in resin extractable inorganic phosphate (δ18OP) of dust particles to identify their P sources. The data presented here is from over 100 PM10 dust samples, collected during major dust events in October- April 2011 and 2012, as part of the CV-DUST project in Cape-Verde. This archipelago is located downwind of the Sahara and Sahel dust producing areas, and is thus well suited for collecting dust blown out from Africa. Air mass back trajectories computations show that the dust origin can be classified to 3 sectors: the north and west Saharan sector, south and central Saharan sector and the Sahel sector. Dust particles approaching from these 3 sectors shows distinct resin-P concentrations (in the range of 1160 μg P g/dust to 7260 μg P g/dust) and distinct δ18OP values which ranges from 7.2‰ to 21.7‰Ṁajor elements concentrations also showed distinct pattern. Dust particles approaching from the north and west Saharan sector shows the lowest P concentrations and a δ18OP values of $\sim$21‰ which are typical for P originating from marine sediments at the Sahara area. Dust particles from the south west Saharan sector are richest in P and have the lowest δ18OP values of 7.2‰ , which are typical for P originated from igneous source. Dust approaching from the Sahel sector shows mid-range P concentrations and δ18OP values of $\sim$14‰ , and fall on isotopic mixing line (R2=0.91) between the dust samples with igneous and marine sedimentary signatures. The diatomite in the Bodélé depression have lower P concentrations (550-900 μg P g/dust) and fall off the mixing line describe by our samples. These findings implies that the bio-available P delivered by dust from West Africa to the Central Atlantic Ocean and later to the Amazon basin is derived from a mixture of igneous origin and marine sedimentary origin, and that in contrast to previous claims, the Bodélé diatomite is not a major dust-P source. In addition, we found that African dust-P concentrations are between 2 folds to 10 folds higher then generally accounted for in modeling studies.