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Speciation, sources, and fate of atmospheric biological organic phosphorus over the East Mediterranean Sea: A missing piece of the P cycle?

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Phosphorus is a critical nutrient affecting primary productivity in large areas of oceanic ecosystems. The principal source of externally supplied nutrients in many marine ecosystems is the atmosphere. As the ocean is an important sink of atmospheric CO_2, phosphorus through productivity limitation can indirectly affect global warming by removing more CO_2 from the atmosphere. The importance of organic P as a potential pool of bioavailable P in the atmosphere is not widely recognized. It is important to note that the only available data in the literature are the atmospheric measurements of phosphate and total phosphorus, while there are almost no data about the organic P, especially over the Mediterranean Sea (MS).

Total Suspended atmospheric Particles (TSP) were collected in eastern MS (Crete) by using high-volume air sampler (N=77) and analyzed for organic P compounds of biological origin such as phospholipids and ATP-like compounds. These compounds were analyzed by liquid chromatography coupled to mass spectrometry at the time of flight mode (Q-TOF-LC/MS) after optimization of the analytical protocols for the matrix of the aerosol samples.

The main phospholipids were analyzed were the phosphatidylcholine (PC), Phosphatidylglycerol (PG) and phosphatidylethanolamine (PE); Phosphatidylcholine is usually the most abundant phospholipid in animals and plants, often amounting to almost 50% of the total complex lipids, while it is less often found in prokaryotic cells. These molecules are the building blocks for cellular membranes yet perform a diverse number of other functions in the cell. Preliminary results on phospholipids showed that phosphatidylcholine was the predominant phospholipid with an average concentration of 14.1$\pm$47.2 pmol m-3, following by PG with an average concentration of 1.9$\pm$8.7 pmol m-3, with percentage contribution to TP 2% and 0.2%, respectively. Negligible was the contribution of PE. It is remarkable that during a dust event the concentration levels of PC and PG were increased 20 and 30 times, respectively, suggesting that the high number of cells delivered by the dust contribute significantly to the atmospheric organic P pool.

Furthermore, the ATP-like compounds were analyzed were ATP (Adenosine TriPhosphate) which is a key molecule of the energetic cell metabolism, ADP (Adenosine DiPhosphate) and AMP (Adenosine MonoPhosphate). Only the AMP was detected in 27% of the total samples; with the average concentration of 0.06$\pm$0.10 pmol m-3, while during a dust event the concentration was increased five times.