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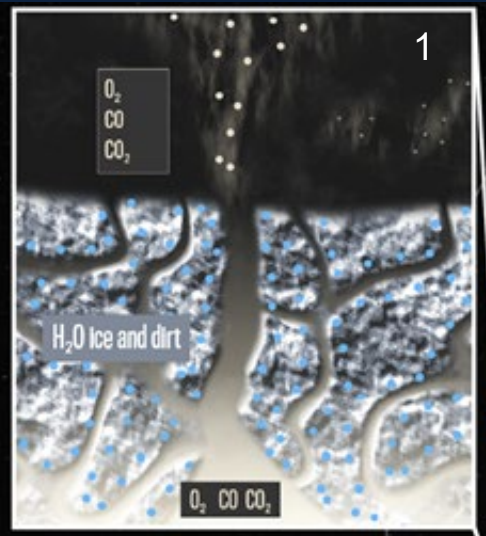
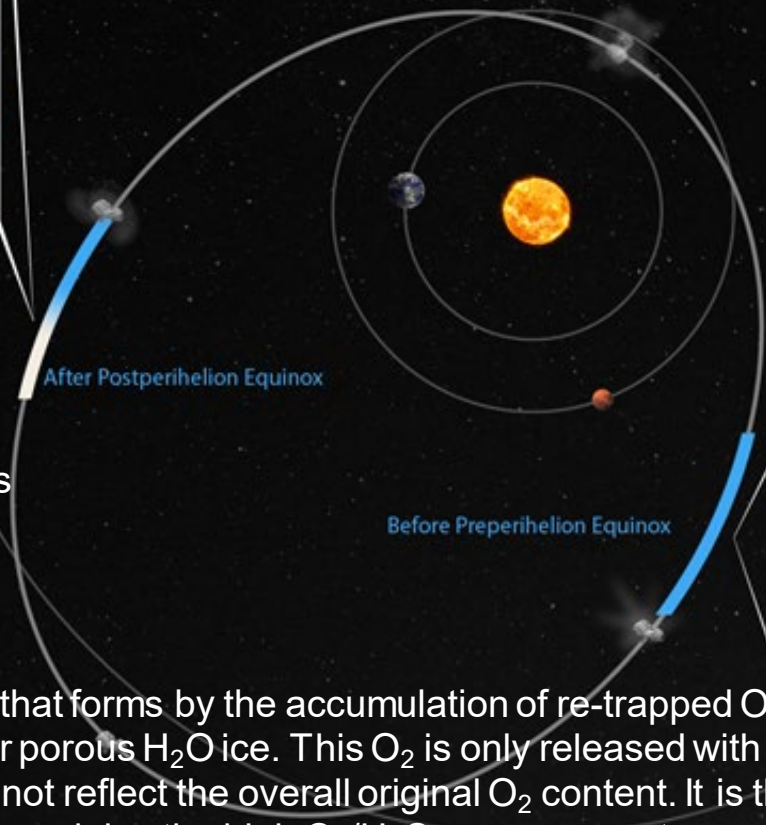
Dual storage and release of molecular oxygen in comet 67P/Churyumov-Gerasimenko

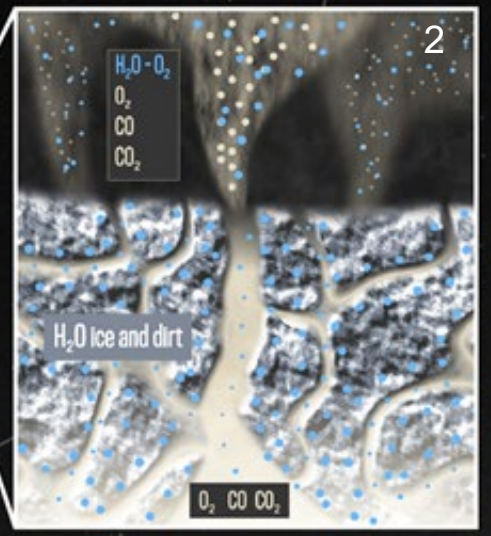


1. Pristine O_2 reservoir at depth incorporated into the comet before nucleus formation. When H_2O sublimation is low, the original source of O_2 and its link with CO and CO_2 instead of H_2O becomes visible.

O_2 was incorporated into the comet's nucleus in a solid and distinct phase before agglomeration *in much lower abundances* than early *Rosetta* measurements imply.



- The remarkably high O_2 and persistently strong O_2-H_2O correlation measured in the coma was assumed to reflect the overall nucleus abundance and a shared chemical origin of O_2 with H_2O, which is difficult to explain.
- We found a hitherto unrecognized change in the correlations of O_2 with H_2O, CO, and CO_2 that rules out an O_2-H_2O link by formation.
- Instead, O_2 in the coma comes from *2 distinct nucleus reservoirs* that have very different origins. There is not that much O_2 in the comet after all.



2. Secondary O_2 reservoir that forms by the accumulation of re-trapped O_2 from depth in the shallower porous H_2O ice. This O_2 is only released with H_2O sublimation and does not reflect the overall original O_2 content. It is the dominant O_2 source, which explains the high O_2/H_2O measurements.

Luspay-Kuti et al. (2022) *Nature Astronomy*