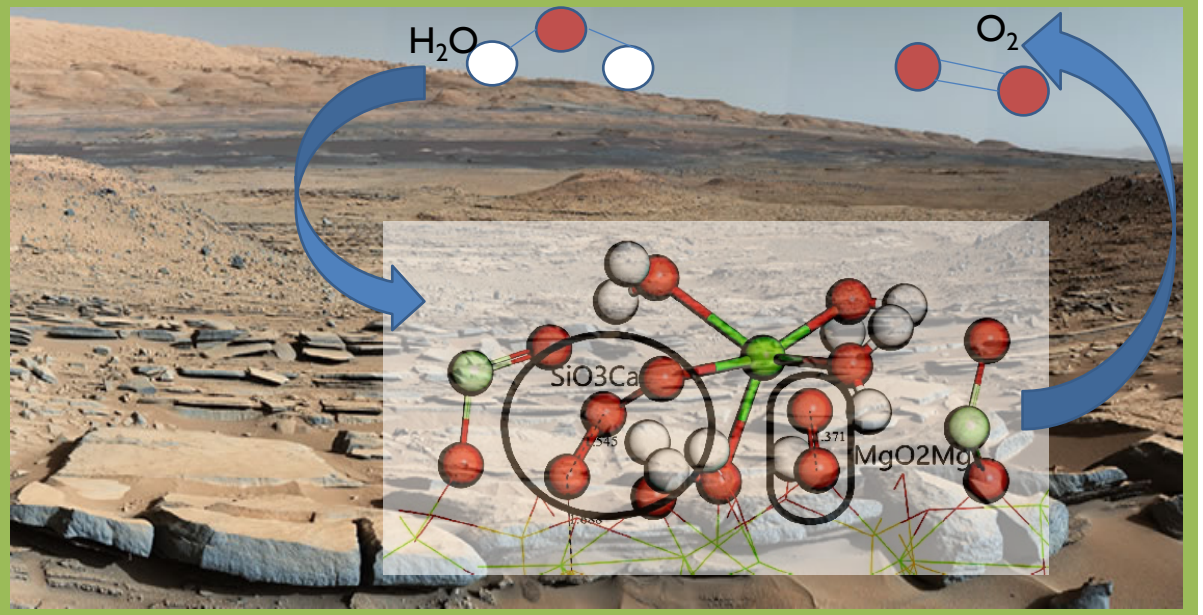
Reduction of perchlorates in the Martian regolith: production of oxygen and ozone, through interaction with olivine and atmospheric water.



Credit: Background "The Kimberley" at Gale Crater, Mars Science Laboratory / NASA
Chemical model: LTU/CAB/IACT, Applied. Surf. Sci.

Perchlorates are widespread in the Martian soil. Ca, Mg and Na perchlorates in the Martian regolith, can hydrate under Martian conditions, when in contact with atmospheric water vapour. This study describes: 1) how olivine catalyses the reduction of calcium perchlorate; and 2) the production of ozone O_3 and oxygen O_2.

Perchlorates $(ClO_4)^-$ have been found widespread on the surface of Mars, at concentrations between 0.5 and 1%. Their origin and degradation pathways are not understood to date. This study investigates the redox processes that take place in the interaction of certain reactive minerals which have been found on Mars, such as olivine, with anhydrous and hydrated perchlorates.

We have used Density Functional Theory theoretical calculations to demonstrate the existence of a reduction pathway from perchlorate to chlorate and chlorite, when in contact with the forsterite surface. When calcium perchlorate is hydrated with more than 4 water molecules, this leads to the reduction of perchlorates, the oxidation of the magnesium of the olivine surface, MgO_2, and the formation of ClO_3, which through photolysis is known to form $ClO\text{-}O_2$. Due to the high levels of UV irradiance on the Martian surface, this may be a source of O_2. This process can be a natural perchlorate removal pathway on Mars.

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