Carbon negative olivine cement

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Magnesium-based binders have demonstrated promise with regards to replacing traditional Ca-based (i.e., lime) cement whether on Earth or Mars. Serpentinization has provided insight on how olivine may be altered or processed to promote alternative Mg-based binders; however, optimizing the release and usability of Mg products from olivine requires further progress. Here, we assess and review several processes related to Mg-based cement production at low temperatures (<600°C) as well as the strength and utility of the Mg-cement produced. As a starting point and limiting factor, Mg needs to be released from olivine. Increasing the surface area of olivine increased Mg release to solution; however, organic solvents such as acetic acid have shown to be more effective than inorganic acids, such as HCl, at releasing Mg from olivine. Based on an iterative process, olivine-based cement was able to achieve a maximum strength in excess of 30 GPa, comparable to Portland cement. Carbon dioxide (CO_2) is capable of being incorporated into Mg-based cement during the mixing and curing process. Current experiments are testing the feasibility and extent that CO_2 can be 'locked' into Mg-based cement. At its optimum, no carbon will be released from olivine (i.e., a silicate) and olivine processing at low temperatures will minimize carbon release. If CO_2 can be effectively fed and solidified into a Mg-based cement, more carbon can theoretically be taken in versus released, thereby, making the production of a Mg-based cement carbon negative.