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Catastrophic emplacement of giant landslides aided by thermal decomposition: Heart Mountain, Wyoming.

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The Heart Mountain landslide of northwest Wyoming is the largest known sub-aerial landslide on Earth. During its emplacement more than 2,000 km^3 of Paleozoic sedimentary and Eocene volcanic rocks slid >45 km on a basal detachment surface dipping 2°, leading to 100 years of debate regarding the emplacement mechanisms. Recently, emplacement by catastrophic sliding has been favored, but experimental evidence in support of this is lacking. Here we show in friction experiments on carbonate rocks taken from the landslide that at slip velocities of several meters per second CO_2starts to degas due to thermal decomposition induced by flash heating after only a few hundred microns of slip. This is associated with the formation of vesicular degassing rims in dolomite clasts and a crystalline calcite cement that closely resemble microstructures in the basal slip zone of the natural landslide. Our experimental results are consistent with an emplacement mechanism whereby catastrophic slip was aided by carbonate decomposition and release of CO_2, allowing the huge upper plate rock mass to slide over a 'cushion' of pressurized material.