LATE-AMAZONIAN CHEMICAL WEATHERING RATE FOR MERIDIANI PLANUM, MARS, DERIVED FROM CANDIDATE STONY METEORITE FINDS

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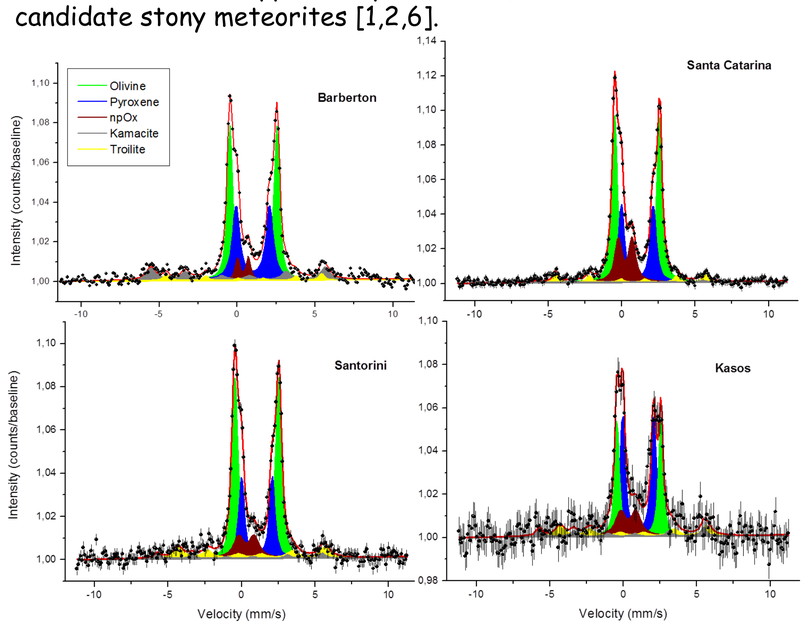
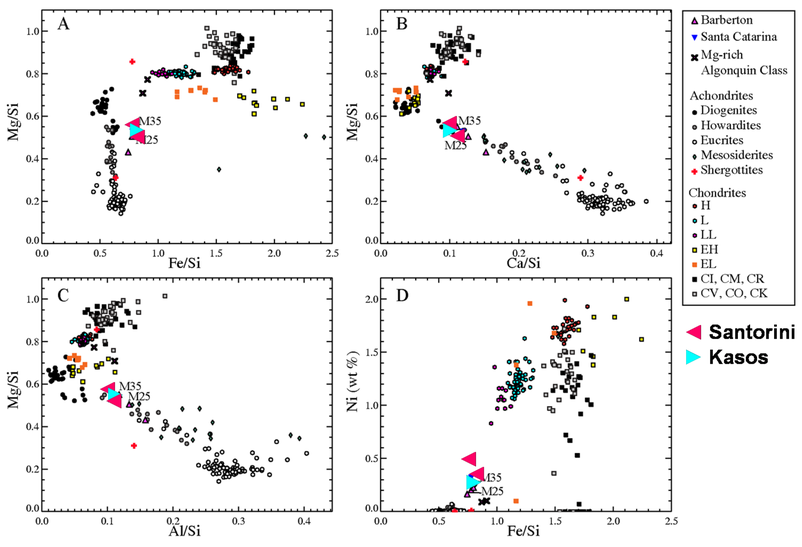
Stony meteorite finds at Meridiani Planum are paired

Both Mars Exploration Rovers (MERs), Spirit and Opportunity, as well as Mars Science Laboratory (MSL) rover Curiosity have come across meteorites on Mars [1-4], and such finds had been predicted [5]. The majority of these finds so far are iron meteorites. MER Opportunity, however, also identified several candidate stony meteorites [1,2,6].



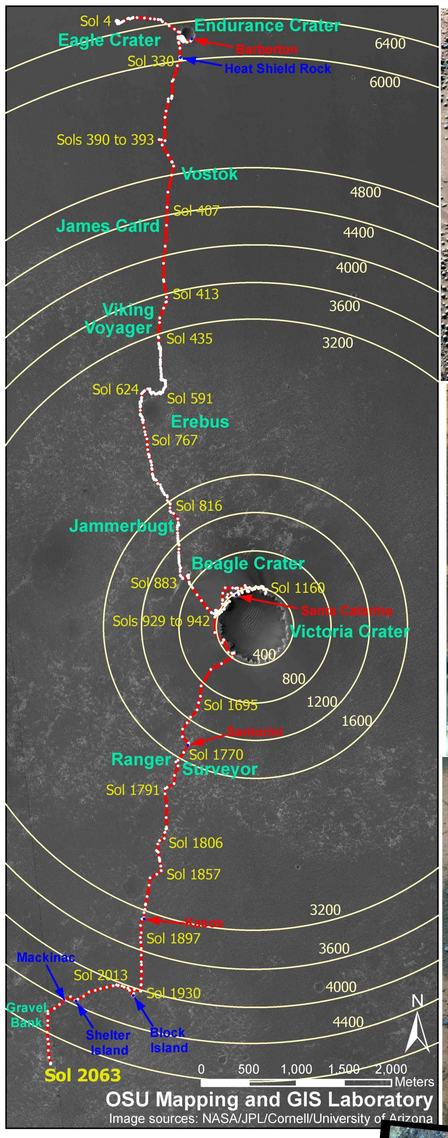
Metallic iron as present in most meteorites is a sensitive tracer for water exposure [7]. Common meteorite types can be thought of as standard calibration points that allow us to quantify chemical weathering: materials with essentially identical compositions that are being deposited continually onto all surfaces in a wide range of environments, with fall compositions that stay the same over geological timescales. The abundance of ferric iron may be taken as a measure of terrestrial alteration [e.g. 8].

Among the loose rock fragments that Opportunity investigated in detail [9,10], four were identified as meteorites on the basis of their metallic iron content [1,2]. The chemical composition of all four is most consistent with the HED group of meteorites although they contain more metal and olivine than HEDs generally do. Because of their chemical and mineralogical similarity and because they appear to belong to a rare group of meteorites rather than ordinary chondrites they are most likely paired.

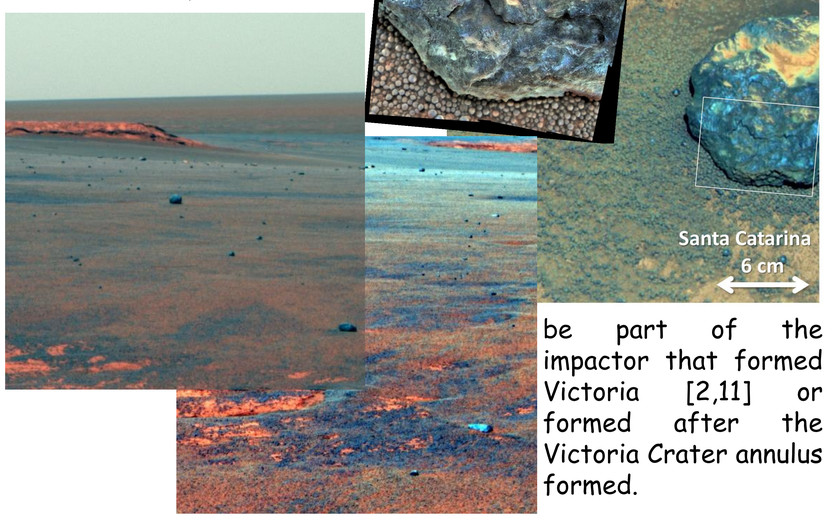


Stony meteorite finds can be linked to Victoria Crater

One of the stony meteorites, dubbed Santa Catarina, was found at the rim of 750 m diameter Victoria crater [11] and part of a wider boulder and cobble field with the same composition as Santa Catarina [2,6,11]. All are located on the Victoria crater annulus, which has been interpreted as the Victoria ejecta blanket that has been eroded and smoothed ~1 m and covered by



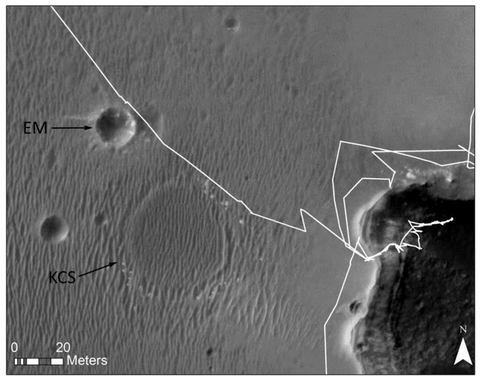
sand [12]. The paired stony meteorites may therfore



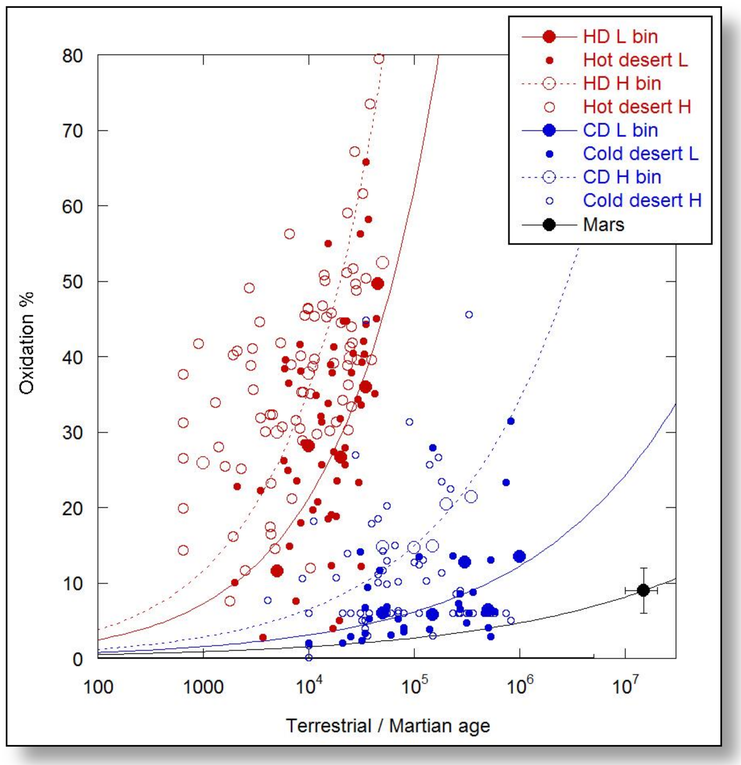
be part of the impactor that formed Victoria [2,11] or formed after the Victoria Crater annulus formed.

Victoria Crater formed ~10 Ma ago

The age of Victoria crater has been estimated at ~10-20 Ma based on the oldest crater on the annulus, with a possible range of 4-25 Ma based on uncertainties and the retention age of craters in this portion of Meridiani Planum [13]. Here we apply 10 Ma as the time of the fall of the stony meteorites.

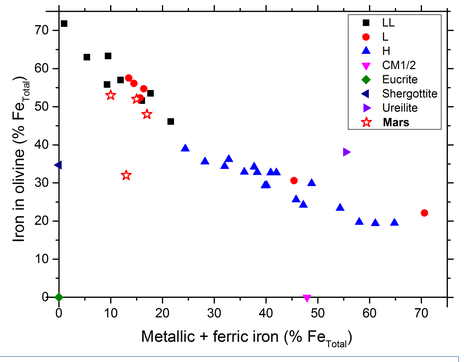


Deriving a weathering rate from meteorites' ferric iron content



Bland and co-workers used ordinary chondrite (H and L) finds from terrestrial hot and cold deserts to determine weathering rates, with ferric iron content measured by Mössbauer spectroscopy [14]. The iron mineralogy and ferric iron content of the Martian finds have been determined using Opportunity's Mössbauer spectrometer [15]. Although the Martian finds are not ordinary chondrites, their iron mineralogy is similar to L and LL chondrites [16], and we can therefore compare weathering rates.

Plotting iron oxidation as a function of terrestrial or Martian age, the Martian chemical weathering rate is significnatly lower than cold (Antarctica) and hot deserts (Sahara, Australia, SW USA) on Earth.



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