The Solar System calcium isotopic composition inferred by Ryugu samples

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Supplementary Information

The Supplementary Information includes:

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Supplementary Methods

The samples were first loaded on a home-made Teflon column filled up with 250 µL of Eichrom DGA resin. Matrix elements were washed out by the addition of 6.75 mL of 4 mol/L HNO_3 and the Ca fraction was collected with 3 mL of water. This procedure was performed twice. To ensure complete removal of Sr, the Ca fraction was redissolved in 0.5 mL of 3 mol/L HNO_3 and loaded on home-made columns filled up with ~100 µL of Eichrom Sr-spec resin, and the Sr-free Ca fraction was collected with an additional 1.5 mL of 3 mol/L HNO_3. After drying down, a few drops of concentrated HNO_3 were added and evaporated to decompose any organic matter leached from the resins during the chemical purification. The Ca fraction was redissolved in 0.5 mol/L HNO_3 for analysis on the Nu Sapphire CC-MC-ICP-MS, at the Institut de Physique du Globe de Paris.

The procedure for Ca isotopic measurements using the Nu Sapphire follows that reported by Dai *et al*. (2022). The samples were analysed at a Ca concentration of 200 ng/mL, which yielded a Ca signal of ~ 300 V with an uptake rate of 100 µL/min. The ^{40}Ca, ^{42}Ca, ^{43}Ca, and ^{44}Ca ion beams were measured with Faraday cups at L6, L1, H3, and H6, respectively. Meanwhile, the intensities of the masses 41 ($^{41}K^{+}$) and 43.5 ($^{87}Sr^{++}$) were monitored on the Faraday cups L5 and H5, respectively. All the cups were connected to 10^{11} Ω amplifiers, except L6 which was connected to a 10^{10} Ω amplifier. Each analysis consisted of a 60-second zero measurement in 0.5 mol/L HNO_3, followed by one block of 30 cycles with 5-second integrations. A 100-second wash was performed in 0.5 mol/L HNO_3 following each standard and sample analysis and a transfer time of 90 seconds was applied. For these conditions, the background on the mass 40 was ~700 mV. The signal on the mass 41 was approximately 25 mV. Each sample was measured 5 or 6 times in a sequence. The mass bias was corrected by measuring the samples alternatively with the SRM 915b standard solution (standard-sample bracketing). The signal on the mass 41 is used to monitor and correct any K present on the mass 40 that would interfere with ^{40}Ca signal.

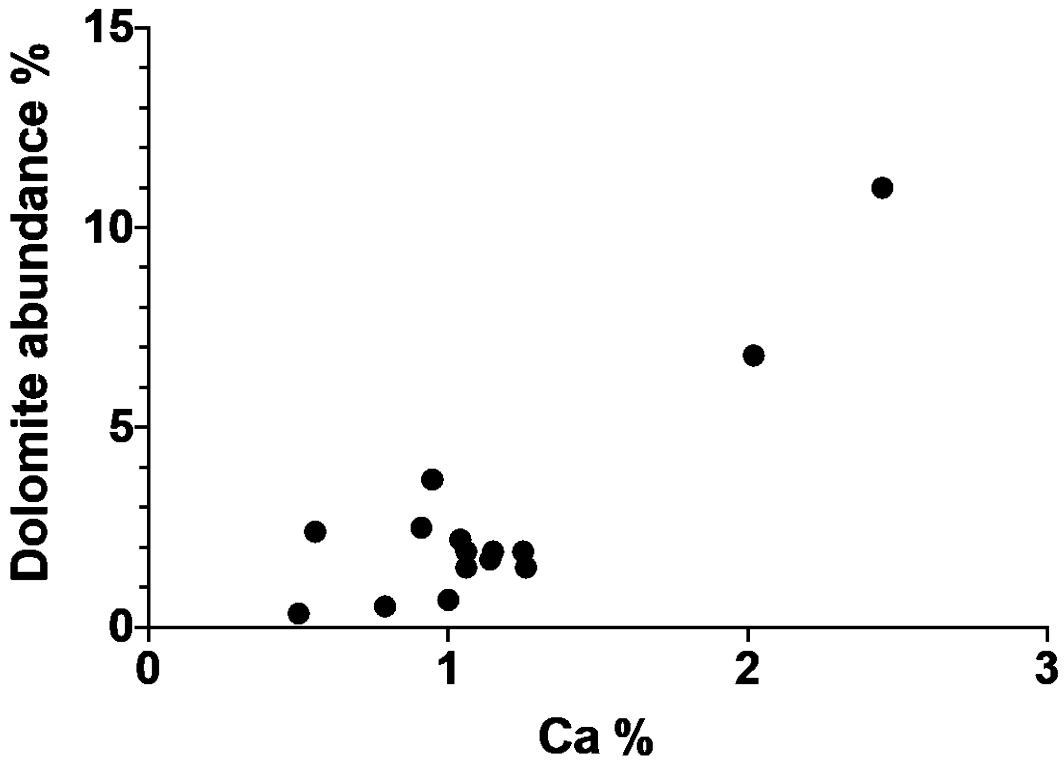

Figure S-1 Dolomite abundance (%) against Ca content (%) in Ryugu grains. Data are from Nakamura E. *et al.* (2022).

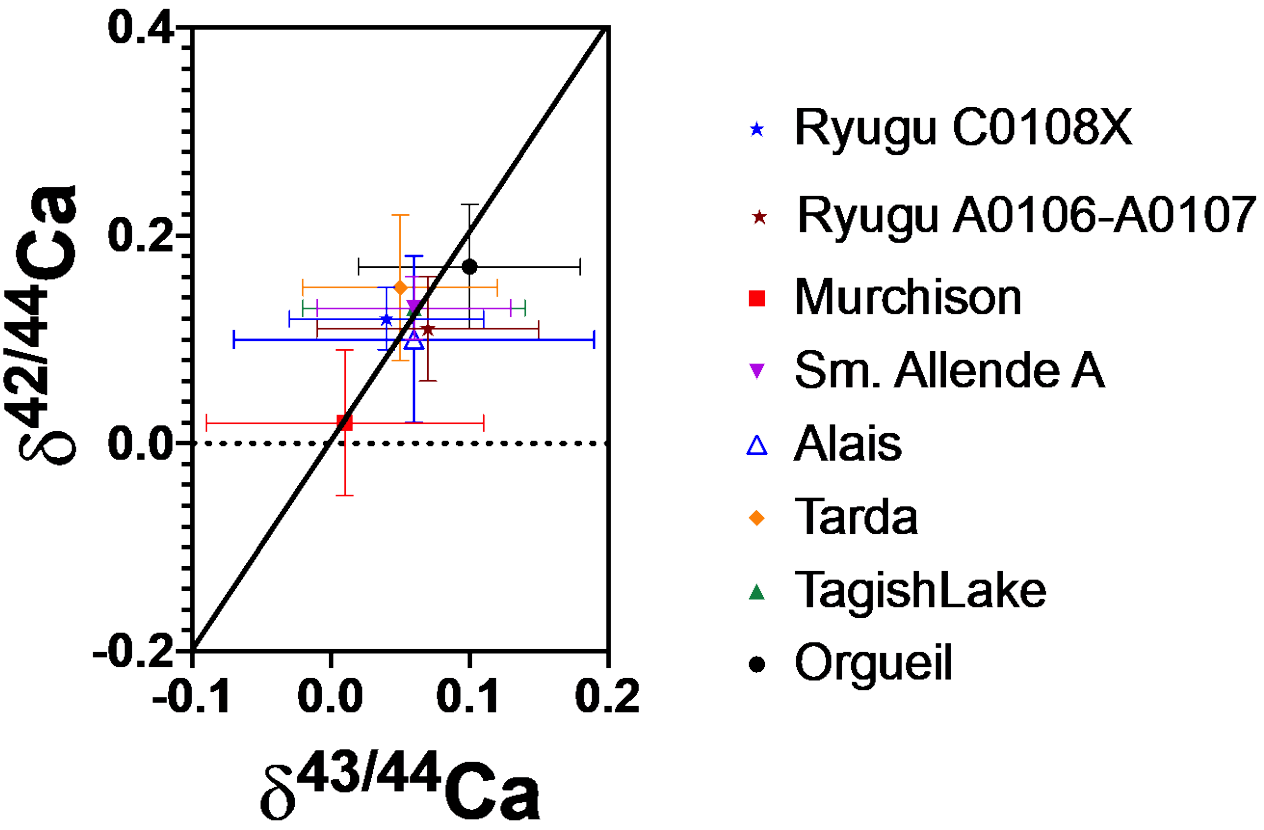

Figure S-2 The $\delta^{44/42}$Ca values plotted against $\delta^{43/44}$Ca values for the various samples analysed in this study, including the Ryugu samples. All the samples fall on a slope 2 mass dependent line within error. Error bars represent 2-sigma standard deviation.

Table S-1 Information on the samples analysed in this study.

Sample Name	ID	Initial weight of sample for making powder	Weight of sample dissolved for isotopic analysis	Source
Ryugu	A0106-A0107	A0106: 1.6 mg A0107: 27.29 mg	23.88 mg	JAXA
Ryugu	C0108	33.34 mg	22.24 mg	JAXA
Orgueil	n219	50 mg	20.82 mg	MNHN
Alais	n25	51 mg	21.98 mg	MNHN
Tagish Lake	not available	1055 mg	24.29 mg	The Meteorite Market
Tarda	not available	212.44 mg	25.10 mg	Meteorite.fr
Murchison	not available	1645 mg	24.76 mg	Michael Farmer Meteorites
Allende	USNM 3529, Split 20 Position 31	4 kg	24.92 mg	Smithsonian

Supplementary Information References

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