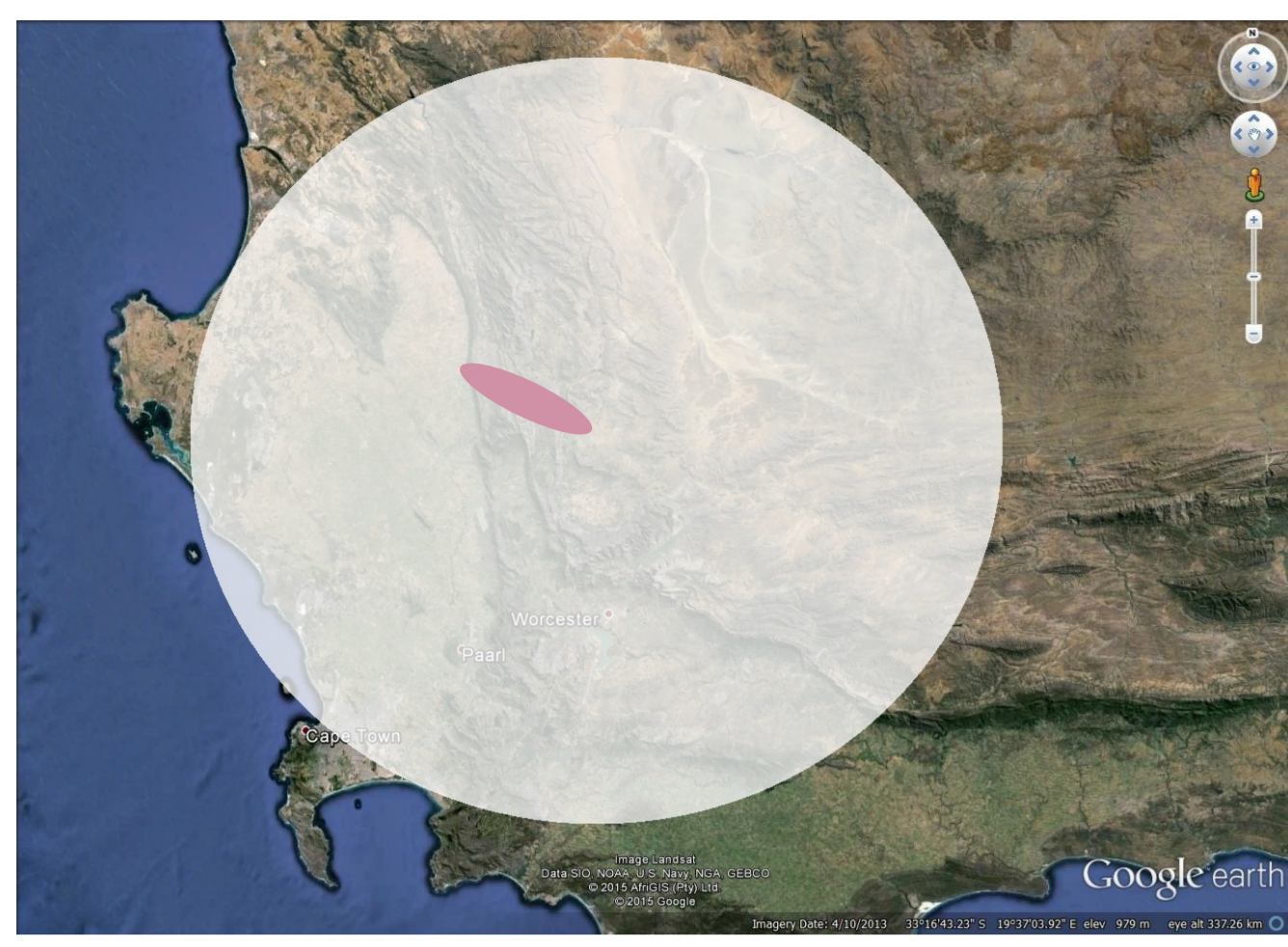


Geography of a cosmic event in South Africa: the Koue Bokkeveld meteor fall (1838)

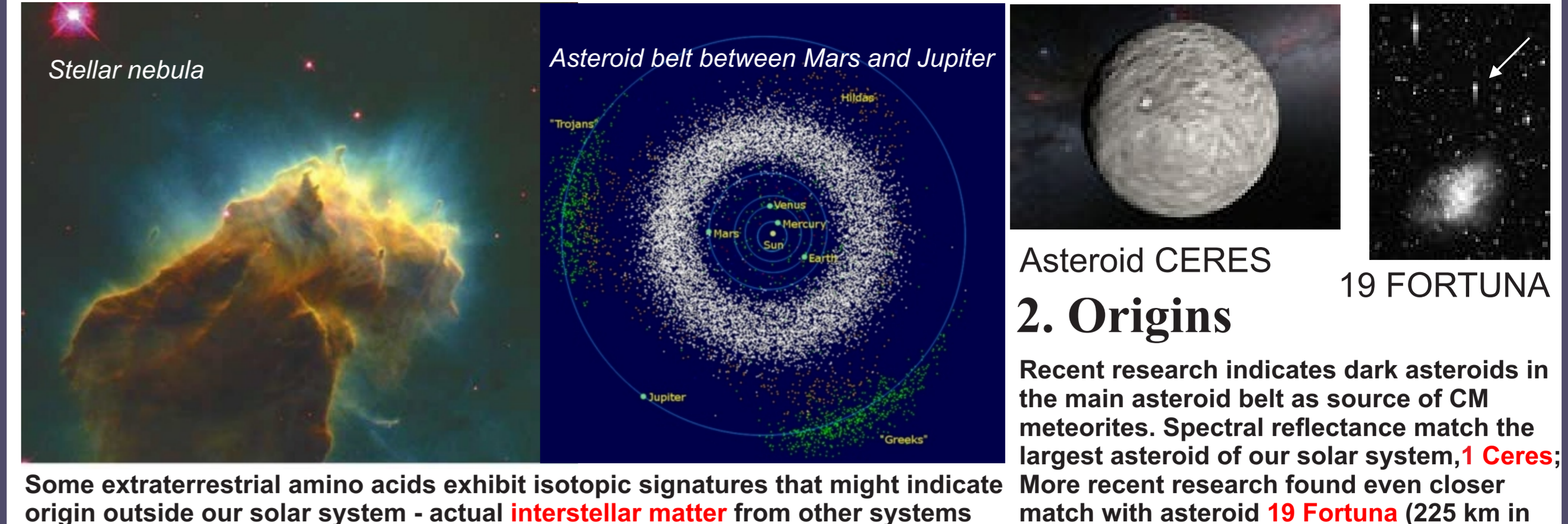
JH van der Merwe

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1. EVENT RECORDING

DATE OF FALL: 13 October 1838
 TIME OF DAY: 09:30
 STREWN FIELD DIMENSIONS:
 20km x 3km (McIntyre 1931; McKenzie 2013)
 Strewn fields are elliptical; largest meteorites in a shower are found farthest down-range in the strewn field
 RECORDED MASS RECOVERED: 9.5kg
 EVENT DESCRIPTION: "The meteor appeared to the best of my judgement to approach from the west with great velocity, and precisely similar to the Congreve rocket of large dimensions. The phenomenon expanded nearly overhead and apparently not more than 3 or 400 feet high, dispersing in large globes the size of forty-two pound shot of quicksilver appearance." (Maclear to Herschel, 1840).
 EVENT MAGNITUDE: Only recorded fall in South Africa;
 One of ~1100 recorded falls worldwide [~38700 Finds recorded]



Some extraterrestrial amino acids exhibit isotopic signatures that might indicate origin outside our solar system - actual **interstellar matter** from other systems and **nebulae** trapped in this meteorite >4.5 billion years ago.

2. Origins

Recent research indicates dark asteroids in the main asteroid belt as source of CM meteorites. Spectral reflectance match the largest asteroid of our solar system, **1 Ceres**; More recent research found even closer match with asteroid **19 Fortuna** (225 km in diameter, nearly spherical)

Affidavit.

I, the undersigned KIEVIET, Bastaard Hottentot, maketh oath, that about the month of October last year I was in the service of BAREND JOOSTE, of the Field Cornetcy of the First Cold Bokkeveld District of Worcester. On the morning of the 13th of that month, my master, myself, and another Bastaard Hottentot named JACOB ROOY, proceeded in a waggon to the mountain at the back of my master's house to fetch wood. It was a fine clear morning; there were no clouds in the sky, and there was no wind. At about nine o'clock A.M., whilst we were busy loading the waggon with the wood, close to the foot of the mountain, we heard a strange noise in the air resembling the loudest thunder we had ever heard, and on looking up we perceived a stream passing over our heads, issuing a noise which petrified us with terror; a burst took place close to the waggon, when something fell and a smoke arose from the grass. My master sent me to look what it was that had fallen, when I found a stone quite warm, so much so that I could not hold it in my hands: I brought it to my master, I do not know what he did with it. This stone now produced to me is part of the one I took up: it might have been about the weight of seven or eight pounds.

Sworn before me at Worcester,
 This 30th day of April 1839, }
 J TREUTER,
 As Witnesses,
 JAMES RATTRAY.

VERNACULAR SUPERSTITION

I saw last week a fine specimen in the hands of a farmer in the country... (belonging to his grandfather... who saw it fall. It must have been in their possession about 60 years. This man had refused 50 dollars for it, as a captain of a ship said it would secure the possessor against the effects of a thunder-storm!" (Maclear, 1840)

An awakening among the coloured people at Worcester commenced about three years previous to our visit, with the falling of an Aerolite on the adjacent part of the Bokkeveld; it was attended by an unusual, thunder-like noise, and other accompaniments which caused some persons to think that the end of all things was at hand. This led some of them to deep searching of heart, in regard to their fitness to meet the Judge of all the earth. One woman, under strong conviction of her sinfulness, fell down on the floor of her cottage, and began to pray fervently for mercy; her little boy, who attended the mission-school, and had never before seen his mother in the suppliant attitude, or heard her call on the Lord out of a broken heart, ran to ... and begged him to go to his mother, for she was praying he obeyed the summons, and found about a dozen others who had joined her, and were also prostrate before the Lord. (Backhouse, 1840)

3. Analysis

KOUE BOKKEVELD METEORITE CLASSIFICATION

- One of 447 approved meteorites classified as CM2
- Carbonaceous chondrite of CM (Highel) group; petrologic type 2
- Class of chondrites with Mg/S ratios near solar value; oxygen isotope compositions below terrestrial fractionation
- Contain small chondrules and refractory inclusions (0.3 mm), abundant fine-grained matrix (~70 vol%) and abundant hydrated minerals.

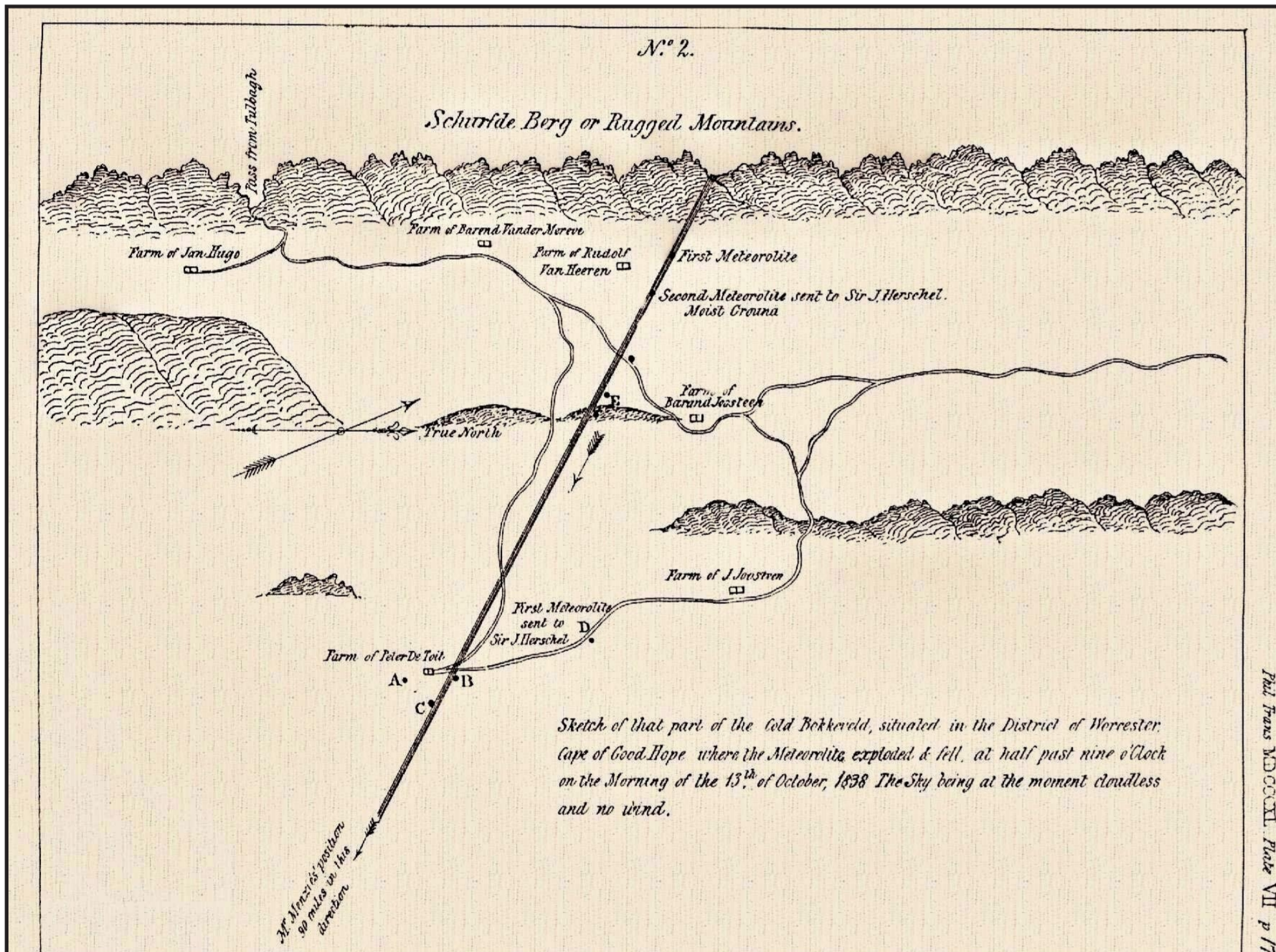
SCIENTIFIC ANALYSIS SHOWS

- some of the most **pristine matter** known.
- nanodiamond, silicon carbide, and other small crystals and phases with **presolar gases** derived from the epochs **before solar system formation**
- rich carbon content** among the most chemically primitive meteorites.
- 15+ amino acids**, some of the **basic components of life**, such as glycine, alanine and glutamic acid
- non-protein amino acid, isovaline**, suggesting an **extraterrestrial source** for molecular asymmetry in the Solar System
- complex organic compounds** delivered by early Solar System: > 230 amino acids (on earth only 20), the fundamental building blocks of life.
- Calcium aluminium rich inclusions (CAIs) similar to those in chondrules underwent **extensive aqueous alteration by water-rich fluids on its parent body** before falling to Earth.
- chemical compositions matching the **chemistry of the Sun**.
- carbonaceous chondrites formed on different parent bodies in different regions of the **early solar nebula**

4. Specimens of Koue Bokkeveld



Natural History Museum (London) specimen with diamond dust extracted from it



Sketch map of strewn field (1840)



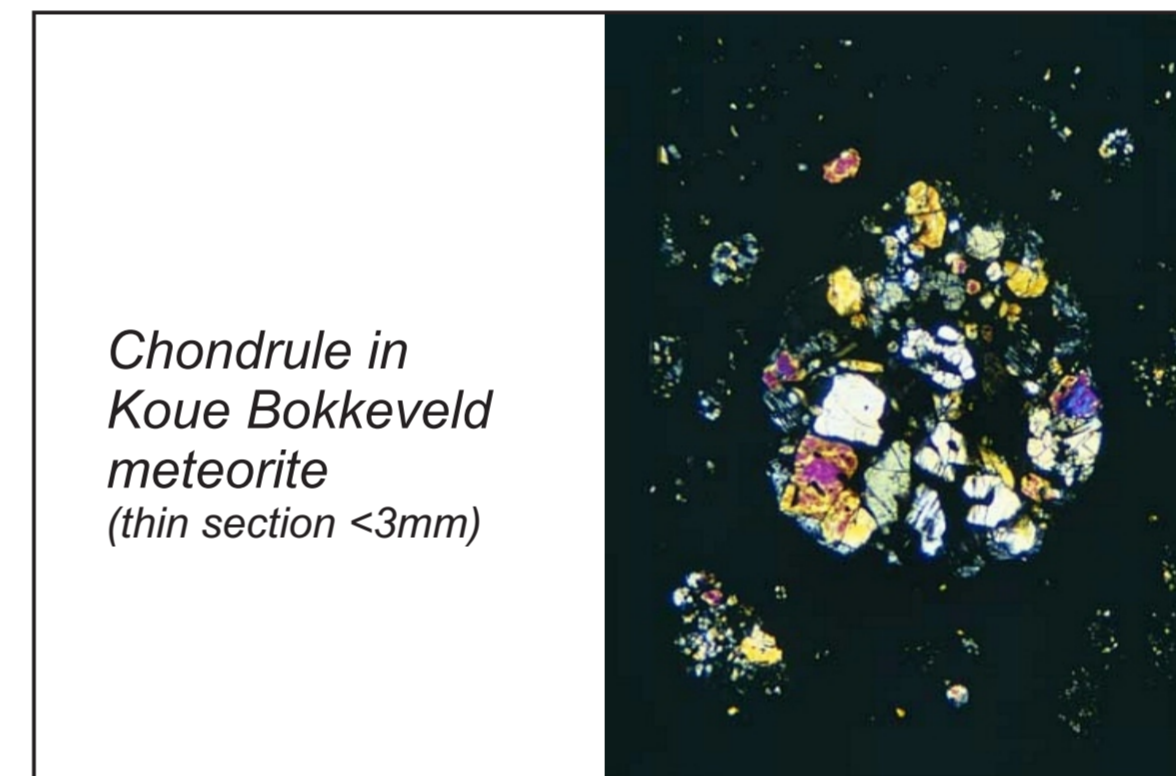
Sketch map of strewn field (1939)

Analysis of Sample 1 (M Faraday 1840)

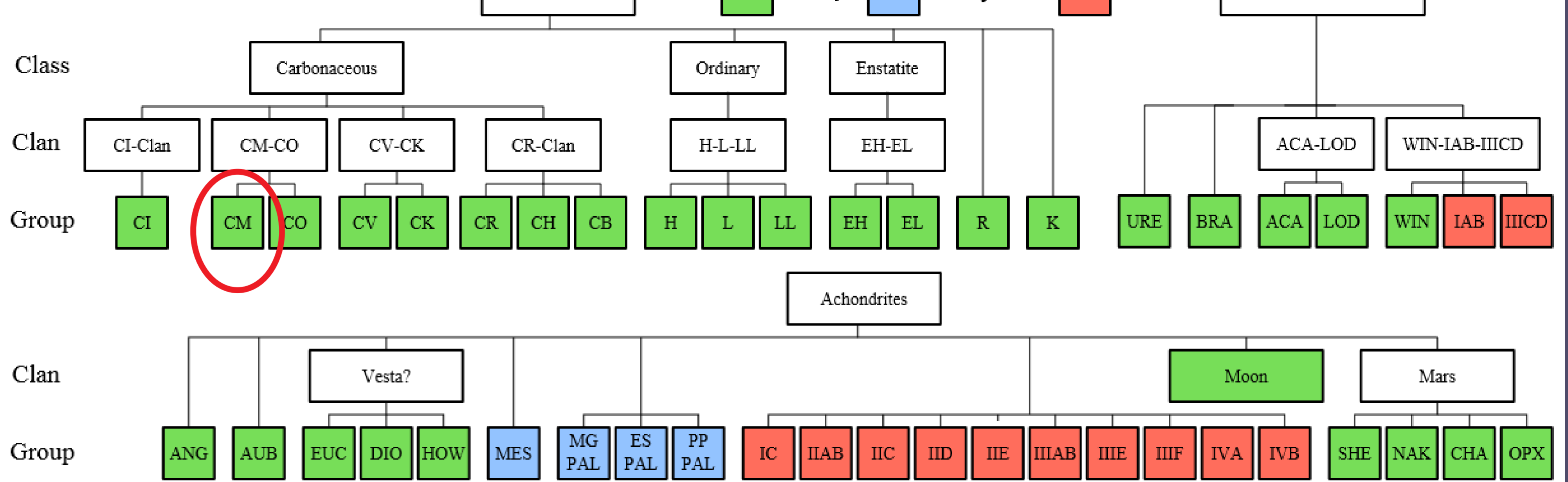
Water	6.5
Sulphur	4.24
Silic	28.9
Prot. of Iron	33.22
Magnesia	19.2
Alumina	5.22
Lime	1.64
Ox. of Nickel	0.82
Ox. of Chrom	0.7
Ox. of Cobalt	trace
Soda	100.44

CURRENT MINERAL LIST (2010)

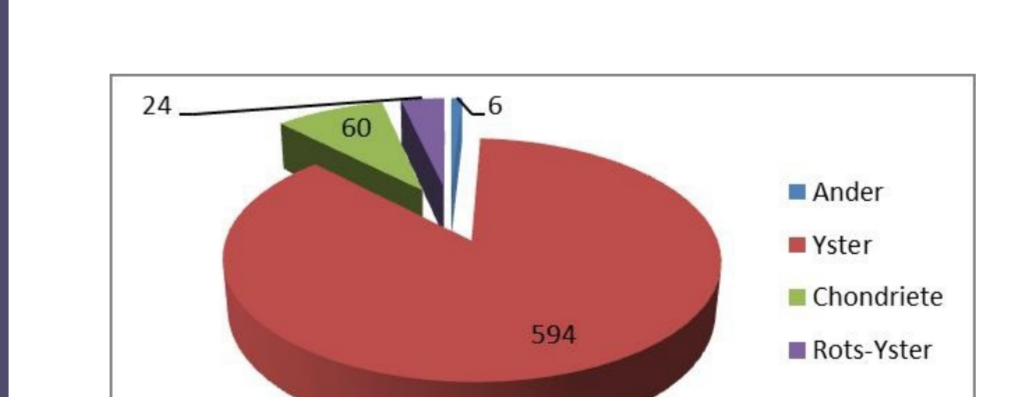
Anhydrite	Aragonite	Augite
Barringerite	Bassanite	Calcite
Chromite	Chrysolite	Clinoenstatite
Cronstedtite	Daubréelite	Diopside
Dolomite	Enstatite	Fayalite
Forsterite	Gypsum	Hibonite
Ilmenite	Iron (var Kamacite)	
Magnetite	Montmorillonite	
'Olivine'	Pentlandite	Perovskite
Pyrrhotite	Rutile	Schreibersite
'Serpentine Group'	Spinel	Sulphur
Tochilinite	Troilite	



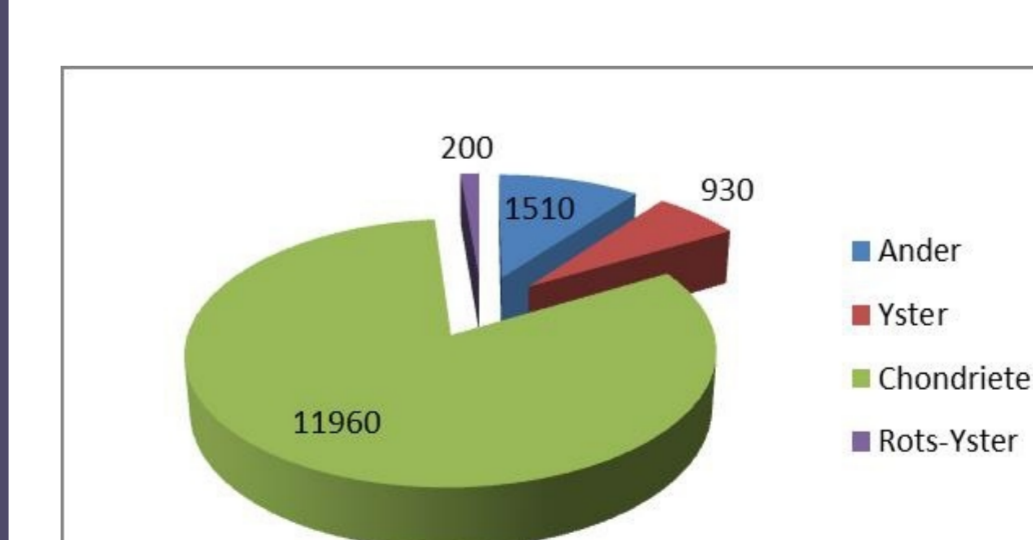
5. Meteor classification



Strewn field 2016



Global meteorites by weight (Ton)



Global meteorites by number

7. Scientific value

"...these meteorites constitute a valuable 'natural laboratory' of prebiotic chemical evolution. Analyses of the organic matter in meteorites can provide an inventory of the types of chemical reactions and organic products which could have been significant on the prebiotic Earth. This inventory substitutes our terrestrial record which has been obliterated by biological and geological activity. In addition, a plausible model has been proposed in which the feedstock for the development of life was supplied by the arrival of meteoritic and cometary organic matter at the surface of the Earth." (Sephton 2002)

6. Trade in meteorites

The Natural History Museum has been accused of selling a fragment of one of Britain's most prized meteorites to cash in on a boom in demand for cosmic items.
 "I recently swapped a Howardite meteorite that sells for \$20/gm for 6g of Cold Bokkeveld which Edinburgh Museum agreed to trade at \$50/gm. It was their property and they are of the opinion that they can do with it what they want. McKenzie (Pers Com 2014)



Koue Bokkeveld meteorite fragment for sale on e-Bay

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