

Meteorites and Minerals Associated With The Origin of Life

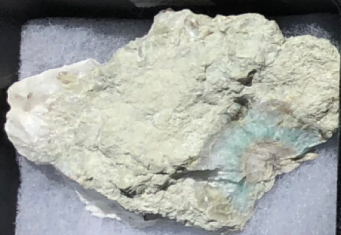
Robert Bruner
Denver Museum of Nature
and Science volunteer

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CHERT FROM SILICA GEL



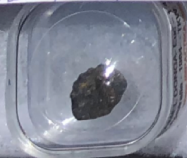
PYRITE



BRUCITE

NAME: *CAMEL DONGA*
 TYPE: *Achondrite-Eucrite*
 FOUND / FELL (DATE): *1984*
 LOCATION: *Western Australia*
 TOTAL KNOWN WEIGHT: *Over 30 kilos*
 SPECIMEN DESCRIPTION: *White*
 SPECIMEN WEIGHT: *1.45g*
 NOTES: *From Vesta!*

VESTA METEORITE



KAOLINITE



BLACK BEAUTY METEORITE

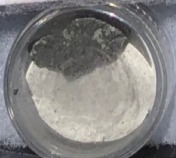
Locality *NEA TO 3A "BLACK BEAUTY"*
 Date *found 2011 - MOROCCO*
 Type *MARTIAN BASALTIC TRACHYA*
 Total Wt. *~ 1kg*
 Notes *0.235g*
 Mile High Meteorites Collection
 www.milehighmeteorites.com

Locality *MURCHISON, AUSTRALIA*
 Date *Fell Sept. 28, 1969*
 Type *CM2*
 Total Wt. *100 kg*
 Notes *Contains Amino Acids*
see additional building blocks
at top
 Mile High Meteorites Collection
 www.milehighmeteorites.com

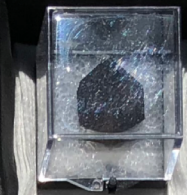
MURCHISON METEORITE

Locality *Allende, Mexico*
 Date *Fell Feb. 8, 1969*
 Type *OV3*
 Total Wt.
 Notes *CAT's older than Sun*

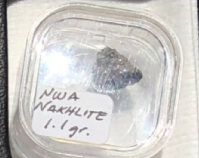
ALLENDE METEORITE



MAGNETITE



NAKHLA



OPALINE SILICA



MORILLONITE



PYROXENE



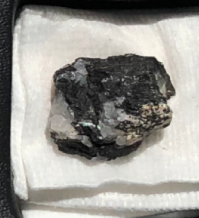
GEYSERITE



WULFENITE



TOURMALINE



COLEMANITE



OLIVINE



SCHREIBERSITE



PUMICE



SERPENTINE



ORGUEIL



TISSINT



METEORITES AND MINERALS ASSOCIATED WITH THE ORIGIN OF LIFE

R.B. Bruner Denver Museum of Nature and Science volunteer

930 S. Euclid Way Denver, Co, 80209 USA

bobbbruner40@hotmail.com

MINERALS

PYRITE- Wachtershauser et al (1)

GEYSERITE- Campbell et al (2)

OPALINE SILICA- Deamer et al (2)

CHERT(FROM SILICA GEL)-Westall et al (9)

PUMICE-Brasier et al (3)

MONTMORILLONITE- Cairns-Smith et al (3)

KAOLINITE-Hashizume et al (3)

OLIVINE- Russell et al (1)

PYROXENE-Russell et al (1)

SERPENTINE-Russell et al (1)

MAGNETITE-Russell et al (1)

BRUCITE-Russell et al (1)

WULFENITE-Benner et al (4)

TOURMALINE-Benner et al (4)

COLEMANITE-Benner et al (4)

context for origin of life

1) under water to protect from impacts on surface

2) on surface to get wet/dry cycles

3) compartments on surface for organic molecules

4) enough dry land to create boron to help RNA

5) method to transfer Mars life to Earth

6) method to transfer organic molecules to planet

7) method to transfer water to planet

8) method to transfer phosphorus to planet

9) protection and wet/dry cycles

METEORITES

MURCHISON(Amino Acids)-Kvenvolden et al (6)

ALLENDE(CAI's)-Clarke et al (6)

TISSINT(Piece of Mars)- Steele et al (5)

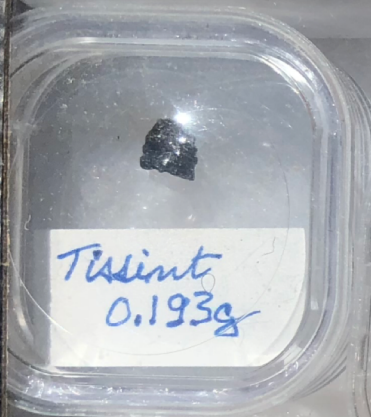
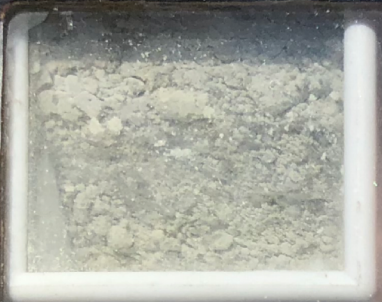
ORGUEIL(Piece of Comet)- Gardinier et al (6)

CAMEL DONGA(Piece of Vesta)- Alexander et al (7)

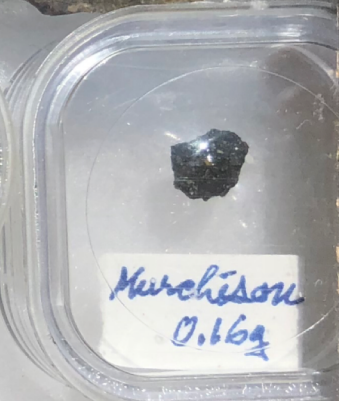
TAMBO QUEMADO (Schreibersite)-Pasek et al (8)

BLACK BEAUTY(Piece of Mars)-Agee et al (5)

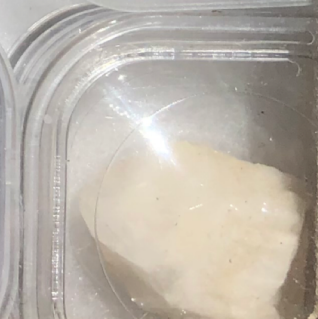
NAKHLA(Piece of Mars)- Bridges et al (5)



Tissint
0.193g



Murchison
0.16g



MINI VERSION OF EXHIBIT OF METEORITES AND MINERALS ASSOCIATED WITH THE ORIGIN OF LIFE

Robert B. Bruner Denver Museum of Nature and Science volunteer bobbbruner40@hotmail.com

930 S. Euclid Way Denver, Colorado, 80209, USA

The Origin of Life explained in minutes to the general public.

I have created this mini version of my Meteorite and Mineral Exhibit for educating people about the Origin of Life. Here is the story.

It is commonly accepted you need three conditions for life to start-

A source of Organic Molecules

A solvent (water)

A source of energy to power the start of life

The piece of the Murchison meteorite (middle right) contains organic molecules

The crust of a rocky planet contains enough water to create an ocean

The sources of energy and location for the start of life have changed over 50 years

In the 70's it was thought to be clay (montmorillonite- top left)

In the 80's it was thought to be black smoker vents on the ocean floor (pyrite- middle left)

In the 2000's it was thought to be white smoker vents on the ocean floor (Serpentinization
Minerals Olivine Serpentine Magnetite Brucite bottom row)

In 2013 it was thought to be Mars because it had enough dry land to create boron
to stabilize ribose in RNA (A meteorite like Tissint- middle left bringing life to Earth)

In 2015 it was thought to be surface hot springs (sinter- top left in pink)

In 2016 it was thought to be volcanic island splash pools (opaline silica- middle right)

In 2017 it was thought to be sediment at the bottom of the ocean in silica gel which
precipitates into chert (upper right)

In future years there will be new sources of energy and locations for the start of life
from new theories.