



Rochester Academy of Science

Larry King Memorial Lecture presented by Dr. Warren Allmon

Director of the Paleontological Research Institution (PRI)

How Paleontology Can Help Save the World



Photo credit: Wikipedia

Paleontology is sometimes thought of as just dinosaurs, or dead fossils. But paleontology is the only record we have of the actual history of life on Earth, and therefore the only test case available for judging the potential effects of present and future environmental change – including climate change -- on Earth's biota. The past is not just past. It is a crucial source of data for predicting, and preparing for, the future.

**Monroe Community College ▫ Monroe A & B - Warshof Conference Center
1:00 p.m. ▫ Saturday, November 9, 2019 ▫ Free**

About our Speaker

Warren D. Allmon is the Director of the Paleontological Research Institution (PRI) in Ithaca, NY and since 2008 the Hunter R. Rawlings III Professor of Paleontology in the Department of Earth and Atmospheric Sciences at Cornell University. He became PRI's fourth Director in 1992.

RAS Scientific Paper Session Schedule

Saturday, November 9, Monroe Community College

Parking: Free. Park in lot M. A campus map can be had at:

www.monroecc.edu/about_mcc/locations_maps/brighton-campus/.

Register to attend, submit your abstract if presenting, order a lunch (optional), and get more information at: <https://sites.monroecc.edu/papersession/>.

8:30 a.m. Presenters sign in. Refreshments for all attendees. Monroe A & B, Warshof Conference Center, Building 3.

9:30 -- 11:45 a.m. Oral Presentations Building 12.

11:45 a.m. -- 12:30 p.m. Poster Session. Atrium and Terrace of the Flynn Center.

12:30 p.m. Lunch (pre-order).

1:00 p.m. Welcome & Larry King Memorial Lecture. Monroe A & B, Warshof Conference Center, Building 3.

Rare-Earth Elements: Their Properties, Technological Applications, and Geostrategic Importance

By Theodore Lechman

As the world progresses from fossil fuel to electrical transportation, and from labor-based manufacturing and service industries to robotics-based industries, the special properties of rare-earth metals in permanent magnet motors and other high-tech materials gives them a crucial role technologically as well as economically.

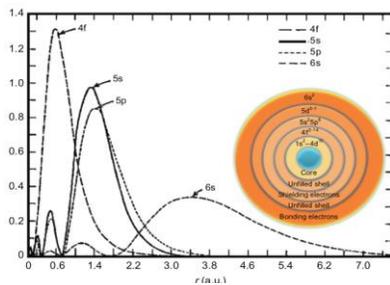
Properties: The rare-earth elements were created from the merger of neutron stars as well as from dying low-mass stars. They constitute the Lanthanide Series of elements in the periodic table, as seen in the figure below. They are found in the 6th row of the table and constitute the elements beginning with Lanthanum, atomic number 57 and ending with Ytterbium, atomic number 70.

The periodic table shows the Lanthanide Series (REE) highlighted in red, starting from Lanthanum (La, atomic number 57) to Ytterbium (Yb, atomic number 70). The Actinide Series (LREE and HREE) is highlighted in yellow and orange, starting from Actinium (Ac, atomic number 87) to Lawrencium (Lr, atomic number 103).

Source: Öko-Institut e.V. (2011)

These 14 elements are associated with the chemically active, or valence, electrons populating the 4f electron orbitals, which can hold up to a max of 14 electrons.

The most unique and important aspects of rare-earths is that these valence (4f) electrons, usually the outer electrons in other metals, are instead buried deep below the outer filled 5s, 5p, and 6s electron orbitals. The highly localized and buried nature of the 4f valence electrons means they do not overlap with neighboring atoms and are instead shielded by these 5s, 5p, and 6s outer electron clouds. As a result, rare-earth atoms in the solid state are much less influenced by their immediate neighbors than other metals, being shielded by the outer filled orbitals.



Rare Earths: Science, Technology, Production and Use. Lucas et al, 2015, p 125.

The result is that rare-earth metals lose much less of their magnetic strength at higher temperatures than do other magnet materials, such as iron. This makes rare-earth metals ideal for high performance and light weight permanent magnets motors, and automotive catalytic converters. The rare-earth metals lanthanum and neodymium are used in lithium-ion and nickel metal-hydride batteries.

Engineering Usefulness: The batteries used in cell phones, portable computers, and electric vehicles all contain rare-earth metals as a key ingredient.

Rare-earth permanent magnet (i.e. “pm”) motors are used in wind-power generators, robotics, electric vehicles, and even your cell phone or smart watch vibrator. They are used in hard disk drives, CD and DVD disk drives. The large traction drive motors in electric vehicles use rare-earth permanent magnet motors for decreased weight, extended battery life and high temperature tolerance. But all vehicles, not just electric vehicles, depend on pm motors to drive power steering, pumps, fans, windshield wipers, power-windows, moon roofs, power-seats, and even the speedometer.

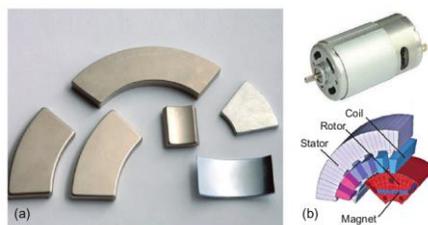
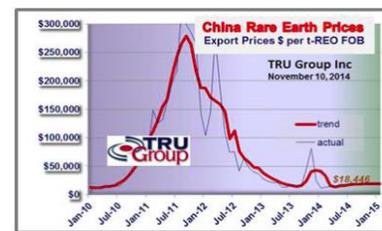


FIG. 14.16 (a) NdFeB magnets shaped in several forms and magnetized in different directions for designing motors for many types of applications. (b) Electrical motors. In the majority of designs the rotor contains the RE magnet and the stator is electrically connected to a load. Courtesy of Shin-Etsu.

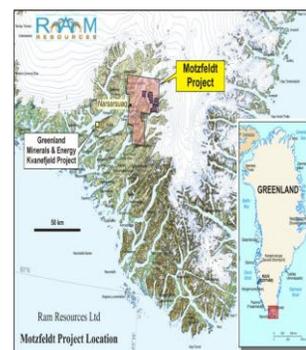
Geopolitical Significance: China dominates rare-earth mining globally (around 95%) as well as controls approximately 36% of rare-earth ore reserves. It dominates the rare-earth

raw material market by undercutting prices and thus forcing other countries mines to close. Around 1990 China declared rare-earths to be a strategic asset and began placing heavy restrictions on the export of raw rare-earths and instead began only exporting rare-earth based finished electronic goods, thereby vertically controlling the rare-earth and high-performance electronics market. This caused a very sharp international price hike in 2011, as Japanese and Korean auto and electronics producers panicked, but prices have dropped since, discouraging non-Chinese mining investment.



North Korean rare-earth metal resources have been valued at over US\$6Trillion by the South Korean national mining company. Over 41% of all Chinese business investment in North Korea is in the mining sector, with raw rare-earth mine output shipped directly to China for processing.

Greenland has recently been in the news. It has strategic value not only in controlling maritime access to the arctic northwest passage and the north Atlantic, but also contains a rare-earth element bearing mine called the Motzfeldt Project located in south west Greenland. The Motzfeldt Project has rare-earth element bearing mineral fields of pyrochlore, bastnaesite, zircon and monazite.



Events for November 2019

For updates to events, check the Academy website, <http://www.rasny.org>, and Section websites.

1 Fri: ASTRONOMY SECTION MEETING

7:30 p.m.–10:00 p.m. RIT Carlson Center for Imaging Science, CAR-1125. Parking Lot F. Speaker: Leslie Hebb, Associate Professor of Physics, Hobart & William Smith Colleges. Topic: Distinguishing Super-Earths from mini-Neptunes; an important step in the search for habitable planets around other Suns. Snacks available at 7:00 p.m. Contact: Mark Minarich (585) 257-6042.

3 Sun: ASTRONOMY PUBLIC OPEN HOUSE

12:00 p.m. - 4:00 p.m. or later. Farash Center for Observational Astronomy, 8355 County Road 14, Ionia NY 14475. Events include observatory training, facilities improvement and star party in the evening – skies permitting. For weather related cancellations or changes contact Mark Minarich; (585) 257-6042 or go to: www.rocheasterastronomy.org/calendar-of-events.

4 Mon: ASTRONOMY BOARD MEETING

7:00 p.m. UR, Bausch & Lomb Hall, 4th floor Chart Room. All ASRAS members welcome. Contact: Mark Minarich (585) 257-6042.

9 Sat: RAS FALL SCIENTIFIC PAPER SESSION

8:30 a.m. - 2:00 p.m. Monroe Community College. Oral and Poster Sessions, 9:30 a.m. -12:15 p.m. Lecture by Dr Warren D. Allmon, 1:00 p.m. See page 1 of this Bulletin for details. Contact: Michael Grenier, (585) 671-8738.

11 Mon: ASTRONOMY SECTION MERCURY TRANSIT

7:36 a.m. – 1:04 p.m. Mercury transits the Sun. Viewing available from Farash Center

Solar Observatory and Youtube.com. See

www.rocheasterastronomy.org/ for details.

12 Tue: FOSSIL SECTION MEETING

7:30 p.m. – 9:00 p.m. Brighton Town Hall, Downstairs Meeting Room. (**PLEASE NOTE:** The Fossil Section meeting is rescheduled due to Election Day). Ashley Pollock of the Niagara Peninsula Geological Society will speak on Precambrian Life and Extinction Events. Contact: Dan Krisher DLKFossil@gmail.com or 698-3147.

16 Sat: LIFE SCIENCES HERBARIUM WORKSHOP

10 a.m. - 2 p.m. Life Sciences section will hold a workshop at the RAS Herbarium, located in the basement of the Rochester Museum and Science Center (RMSC). No experience needed! If you plan to attend, Please RSVP Elizabeth Pixley, herbarium curator, at 334-0977 or evpixley@gmail.com.

19 Tue: MINERAL SECTION MEETING

7:00 p.m. Brighton Town Hall, Downstairs Meeting Room. Speaker Don Lapham of the Buffalo Geological Society will present “Minerals of the Lockport Dolomite in Western NY and Southern Ontario”. Join us for an evening learning about the minerals in the bedrock below us, door prizes, and refreshments. Contact: Stephen Busschaert (585) 351-7633.

20 Wed: RAS BOARD MEETING

7:00 p.m. Brighton Town Hall, Stage Conference Room.

23 Sat: ASTRONOMY SECTION MEMBERS OBSERVING

New Moon Weekend. 10:00 p.m.-? Weather permitting. Farash Center for Observational Astronomy, 8355 County Road 14 Ionia, NY 14475. Contact Mark Minarich: (585) 257-6042.

ONGOING EVENTS EVERY MONTH

STRASENBURGH OBSERVATORY

ASRAS will operate the telescope at Strasenburgh Planetarium on mostly clear Saturday nights.

ASTRONOMY STAR PARTY

ASRAS also hosts public outdoor star parties once a month on Fridays, either at Mendon Ponds Park or Northampton Park near Brockport. Check on prior Wednesday at ASRAS Facebook page, and www.rocheasterastronomy.org/calendar-of-events.

OUTSIDE EVENTS IN NOVEMBER

3 Sun: DAYLIGHT SAVINGS TIME ENDS Clocks “fall back” one hour at 2:00 a.m.

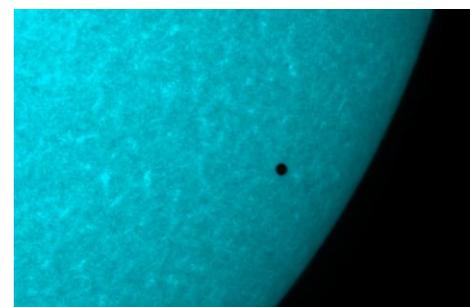
5 Tue: ELECTION DAY

28 Thu: THANKSGIVING DAY

The Cretaceous catastrophe, millions of years of evolution, the breeding talent of humans, and a good cook led to the tasty treat displayed at your table. Enjoy!



Happy Thanksgiving!



Transit of Mercury Across the Sun May 9, 2016 from Farash Center Solar Observatory in the light of singly ionized Calcium.

Courtesy ASRAS Ionia Crew

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November 2019 - Vol. 73, #9, Page 4

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For information, contact President Michael Grenier at (585) 671-8738 or by e-mail: pres@rasny.org.

The Academy Internet website is

<http://www.rasny.org>

Or see us on Facebook at

<https://www.facebook.com/RochesterAcademyofScience>.

This "**BULLETIN**" is produced monthly, except July and September, by the Astronomy Section, Rochester Academy of Science. Submissions are due by the 10th of the month and may be emailed to: editor@rasny.org.

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