NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

MEETING ANNOUNCEMENT

DATE: **February 24, 2016**

LOCATION: **Orinda Masonic Center, 9 Altarinda Rd., Orinda**

TIME: **6:30 p.m. social; 7:00 p.m. talk (no dinner) Cost: $5 per regular member; $1 per student or K – 12 teachers**

SPEAKER: **Robert Davies, Professor of Astronomy, Geology & Physical Science, Merced College**

Topic: Living Above the Fossil Zoo: 23 Million Years of Geologic History Under the Central Valley

Our February speaker has spent much of his professional career studying the post-Miocene fauna of the Central Valley in California. This period covers the marine and terrestrial animals that inhabited the shallow coastal areas of the Central Valley immediately preceding the transition of the North American-Pacific Plate boundary from a subduction regime to the San Andreas strike-slip style that continues today. Marine shellfish and coral colonies were gradually replaced by terrestrial mammals as the Coast Range uplifted and the Central Valley marine waters receded westward. This presentation will chronicle the last 23 million years of faunal evolution from the Miocene epoch through the Pleistocene era, richly illustrated with representative fossils from each time period. Our speaker will also bring fossil samples to the meeting so members can better visualize the major faunal types that existed at various points along this time line.

Biography: Robert Davies has taught geology, astronomy, and physical science at Merced College for nine years. His first love is the world of fossils and prehistoric life. His Master's thesis was on the evolution and body structure of mammoths during the Pleistocene Era, beginning about 2.5 million years ago. He envisions the Central valley of California under water during Miocene times 23 million years ago. As the seas receded, the climate grew warmer and the Central Valley evolved to look much like the current day African savannah. His fossil collection includes a variety of fauna from Miocene to Pleistocene times.

NCGS 2015 – 2016 Calendar

March 30, 2016 **7:00 pm**
Dr. Jeff Unruh, Lettis Consultants International Inc.
Tectonics of Mount Diablo and Vicinity

April 27, 2016 **7:00 pm**
Dr. Ronald Olowin, Department of Physics and Astronomy, Saint Mary's College
Title to be determined

May 25, 2016 **7:00 pm (dinner meeting)**
Dr. Charles K. Paull, Monterey Bay Aquarium Research Institute
Sediment Movement through Monterey and other Submarine Canyons along the California Coast

June 22, 2016. **7:00 pm**
Jerome V. De Graff, CSU Fresno, Richard H. Jahns Lecturer for 2016 by the Association of Environmental & Engineering Geologists and the Geological Society of America
Fire, Earth & Rain

NCGS Field Trips

Field trips in a preliminary planning stage:

- Geology of Devil's Slide
- Pt. Sal Ophiolite in Santa Barbara Co,
- Convergent Margin Tectonics across Central California Coast Ranges - Pacheco Pass
- Tuscan Formation volcanic mudflow deposits, Cascade foothills

Peninsula Geologic Society

For an updated list of meetings, abstracts, and field trips go to http://www.diggles.com/pgs/. The PGS has also posted guidebooks for downloading, as well as photographs from recent field trips at this web address. Please check the website for current details.

UC Berkeley Earth & Planetary Science Weekly Seminar Series

On Thursday, Feb. 25 at 4 pm at 141 McCone, Bill Boos of Yale University will speak on the topic "**On abrupt changes in monsoons: the response to geologic uplift and next-century climate change**"

For an updated list of seminars go to http://eps.berkeley.edu/events/seminars.

Early Career Scientists Sought to Speak in K-12 classrooms

The following is an email from The National Center for Science Education received by the Kathleen Burnham; it may be of interest to some of our members. NCSE provides information and advice on keeping evolution and climate change in the science classroom.

Dear Kathleen,

The National Center for Science Education is piloting a new program this fall to get early career scientists into K-12 classrooms to talk about climate change and evolution!

We are looking for all types of early career scientists, from graduate students all the way up to folks in their first years of their academic positions. The time commitment for the program is low, just one in-class visit and regular monthly social media interactions throughout the semester, but the impact will be enormous. This is a great opportunity for scientists looking to share their work with a broader audience and inspire a new generation of scientists and science-loving citizens.

Interested? Intrigued? Know of a great fit for such a new and innovative program? Perfect! Sign up yourself, share with colleagues or departments who might be interested, and send some early career scientists our way!

To find out more about the program and sign up, visit our website or contact Minda Berbeco at berbeco@ncse.com.

Sincerely,
Minda Berbeco
Programs and Policy Director
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A Reminder: *It's Renewal Time!* Our Year Runs From September to September. Please Use the Renewal Form Included as Page 11 of the Newsletter.

Job Opportunity with East Bay Regional Park District

One of our members noticed a posting by the local Chapter of AEG noting that a Mining Operations Supervisor is needed by East Bay Regional Park District. The information can be accessed at this link:

http://aegsf.org/archives/1626

Applications are open until March 2. Please note that this is a courtesy posting. The NCGS has no other information regarding this position. Please check the AEG link to find out more. Thank you.

Report on the Napa Earthquake, California (M6, 2014-08-24)

Open the following link for a report by the French agency IRSN on the 2014-08-24 Napa County earthquake:
http://paleoseismicity.org/irsn-report-on-the-napa-earthquake-california-m6-24-08-2014/

Recent Articles of Seismic Interest

Here are two recent articles from the local newspaper: One on Bay Area seismic hazards, and another on a new mobile app for finding potential seismic hazards around the world:
http://www.sfchronicle.com/bayarea/article/New-data-on-2-Bay-Area-faults-cause-worry-about-6731300.php#photo-2356934

and

http://www.sfgate.com/science/article/App-tracks-risks-ranks-hazards-of-nearby-6655125.php

Mammal diversity exploded immediately after dinosaur extinction

Leptictis fossil.
Credit: Courtesy of Dr Thomas Halliday

The diversity of mammals on Earth exploded straight after the dinosaur extinction event, according to University College London (UCL) researchers. New analysis of the fossil record shows that placental mammals, the group that today includes nearly 5000 species including humans, became more varied in anatomy during the Paleocene epoch -- the 10 million years immediately following the event.

Senior author, Dr. Anjali Goswami (UCL Genetics, Evolution & Environment), said: "When dinosaurs went extinct, a lot of competitors and predators of mammals disappeared, meaning that a great deal of the pressure limiting what mammals could do ecologically was removed. They clearly took advantage of that opportunity, as we can see by their rapid increases in body size and ecological diversity. Mammals evolved a greater variety of forms in the first few million years after the dinosaurs went extinct than in the previous 160 million years of mammal evolution under the rule of dinosaurs."

The Natural Environment Research Council-funded research, published in the *Biological Journal of the Linnean Society*, studied the early evolution of placental mammals, the group including elephants, sloths, cats, dolphins and humans. The scientists gained a deeper understanding of how the diversity of the mammals that roamed Earth before and after the dinosaur extinction changed as a result of that event.

Placental mammal fossils from this period have been previously overlooked as they were hard to place in the mammal tree of life because they lack many features that help to classify the living groups of placental mammals. Through recent work by the same team at UCL, this issue was resolved by creating a new tree of life for placental mammals, including these early forms, which was described in a study published in *Biological Reviews* yesterday.

First author of both papers, Dr. Thomas Halliday (UCL Earth Sciences and Genetics, Evolution & Environment), said: "The mass extinction that wiped out the dinosaurs 66 million years ago is traditionally acknowledged as the start of the 'Age of Mammals' because several types of mammal appear for the first time immediately afterwards.

"Many recent studies suggest that little changed in mammal evolution during the Paleocene but these analyses don't include fossils from that time. When we look at the mammals that were present, we find a burst of evolution into new forms, followed by specialisation that finally resulted in the groups of mammals we see today. The earliest placental mammal fossils appear only a few hundred thousand years after the mass extinction, suggesting the event played a key role in diversification of the mammal group to which we belong."

The team studied the bones and teeth of 904 placental fossils to measure the anatomical differences between species. This information was used to build an updated tree of life containing 177 species within Eutheria (the group of mammals including all species more closely related to us than to kangaroos) including 94 from the Paleocene -- making it the tree with the largest

representation from Paleocene mammals to date. The new tree was analysed in time sections from 140 million years ago to present day, revealing the change in the variety of species.

Three different methods were used by the team to investigate the range and variation of the mammals present, and all showed an explosion in mammal diversity after the dinosaur extinction. This is consistent with theories that mammals flourished when dinosaurs were no longer hunting them or competing with them for resources.

Dr Anjali Goswami (UCL Genetics, Evolution & Environment), added: "Extinctions are obviously terrible for the groups that go extinct, non-avian dinosaurs in this case, but they can create great opportunities for the species that survive, such as placental mammals, and the descendants of dinosaurs: birds."

Professor Paul Upchurch (UCL Earth Sciences), co-author of the Biological Reviews study, added: "Several previous methodological studies have shown that it is important to include as many species in an evolutionary tree as possible: this generally improves the accuracy of the tree. By producing such a large data set, we hope that our evolutionary tree for Paleocene mammals is more robust and reliable than any of the previous ones. Moreover, such large trees are very useful for future studies of large-scale evolutionary patterns, such as how early placental mammals dispersed across the continents via land bridges that no longer exist today."

The team are now investigating rates of evolution in these mammals, as well as looking at body size more specifically. Further work will involve building data from DNA into these analyses, to extend these studies to modern mammals.

Story Source: The above post is reprinted from materials provided by University College London.

Journal References: Thomas John Dixon Halliday, Anjali Goswami. **Eutherian morphological disparity across the end-Cretaceous mass extinction**. *Biological Journal of the Linnean Society*, 2015; DOI: 10.1111/bij.12731

1. Thomas J. D. Halliday, Paul Upchurch, Anjali Goswami. **Resolving the relationships of Paleocene placental mammals**. *Biological Reviews*, 2015; DOI: 10.1111/brv.12242

Some 5,000 years ago, silver mining on the shores of the Aegean Sea

An exceptional archaeological discovery at Thorikos (Greece)

A mining archaeologist is at work in a 5,000-year-old silver mine in Thorikos, Greece.

Credit: Ghent University

The team of mining archaeologists was supervised by Prof. Dr. Denis Morin of the University of Lorraine, connected with the UMR CNRS 5608 (UMR National Center for Scientific Research 5608) of Toulouse. The scientists employed a drone to locate above-ground installations connected to the mining. It is the first time that such complex mining infrastructure is studied.

These subterranean investigations are part of a larger archaeological research program on the site of Thorikos directed by Prof. Roald Docter of Ghent University under the auspices of the Belgian School at Athens, the University of Utrecht and the Ephorate of Eastern Attica.

Denis Morin on this discovery: "Today, it is difficult to imagine the extreme conditions in which the miners had to work in this maze of galleries. A smothering heat reigns in this mineral environment. The progress of the underground survey requires a constant vigilance in this stuffy space where the rate of oxygen must be permanently watched. Tool marks on the walls, graffiti, oil lamps, and crushing areas give evidence of the omnipresent activity of these underground workers. The hardness of the bedrock and the mineralizations show the extreme working conditions of these workers, for the greater part slaves, sentenced to the darkness and the extraction of the lead-silver ore ... Mapping these cramped, complex and braided underground networks, the ramifications of which are sometimes located at several levels, represent a real challenge in scientific terms." Underground, the morphology and the organization of the mining infrastructure allow the distinguishing of several phases of activity.

The archaeological data gathered and observed during the latest phase of the 2015 campaign: pottery, stone

hammers made of a volcano-sedimentary rock quarry, point towards a high dating for the earliest phase of mining activities in the area (Late Neolithic / Early Helladic: around 3200 BC). If future research confirms this hypothesis, the chronological framework of mining in the region of Attica and the Aegean world would be profoundly modified. The Classical phase is by far the most perceptible; omnipresent, it is remarkable by the regularity of the sections of divided galleries that cover the whole space. Fragments of pottery and oil lamps, and even a Greek inscription engraved on a wall, testify to the activities in this period. Conduits cut with pointed tools, of quadrangular shape, cutting of the rock in successive stages, such are the characteristics of these particularly well organized mining works.

This resumption of the works at the end of Classical period (4th century BC) is dated by the tool marks in the galleries and the ceramic remains. Shafts discovered inside this network connect two main levels of mineralizations, and hence of extraction. Of perfect geometrical architecture, executed to the millimeter, their technique of construction is still being investigated by the archaeologists.

Today, these shafts are only accessible using techniques of alpine caving. A certain number of these abandoned galleries has remained untouched over the last 5000 years. Others, which are now inaccessible, had been entirely banked up during successive phases of mining. Progressing in these galleries remains difficult for the experienced archaeologists, wearing high-tech equipment, in a stifling atmosphere with temperatures up to 21°C.

The mine that has been discovered in Thorikos is exceptional in its layout and extension. Up to now mining archaeologists working in the Laurion area did not explore such a complex network of galleries and mining infrastructure. They show the physical capacities and skills of the ancient miners to exploit these complex ore deposits and to assure ore dressing activities outside the mine from the Prehistory on. It testifies to a deliberate strategy and to perfect technological and spatial control over the process: an exceptional concentration of means to extract silver and a sophisticated technical system that in its scale is unique within the ancient world.

Already exploited since the 4th / 3rd millennium BC, by the 5th and 4th centuries BC these silver mines constituted the most important mining district of Greece, laying at the basis of Athens' domination of the Aegean world.

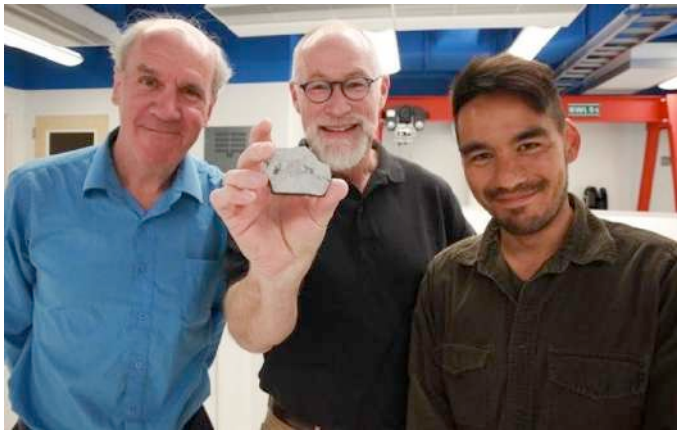
The 2015 underground survey campaign brought new information on the mining techniques developed since the first metal ages in this strategic zone of the eastern Mediterranean. The ongoing research not only aims to survey these subterranean remains, but it will also allow us to understand the mining technologies of these early periods, the management of mineral resources, their extraction and processing as well as the circulation of the end products... These achievements of human ingenuity already foreshadow the technological advances of the Middle Ages.

Story Source: The above post is reprinted from materials provided by Ghent University.

Citation: Ghent University. "Some 5,000 years ago, silver mining on the shores of the Aegean Sea: An exceptional archaeological discovery at Thorikos (Greece)." ScienceDaily. ScienceDaily, 10 February 2016. <www.sciencedaily.com/releases/2016/02/160210110630.htm>.

Moon was produced by a head-on collision between Earth and a forming planet

Research reconstructs massive crash, which took place 4.5 billion years ago



This image shows from left Paul Warren, Edward Young and Issaku Kohl. Young is holding a sample of a rock from the moon. Credit: Christelle Snow/UCLA

The moon was formed by a violent, head-on collision between the early Earth and a "planetary embryo" called Theia approximately 100 million years after the Earth formed, UCLA geochemists and colleagues report.

Scientists had already known about this high-speed crash, which occurred almost 4.5 billion years ago, but many thought the Earth collided with Theia (pronounced THAY-eh) at an angle of 45 degrees or more -- a powerful side-swipe (simulated in this 2012 YouTube video). New evidence reported Jan. 29 in the journal *Science* substantially strengthens the case for a head-on assault.

The researchers analyzed seven rocks brought to the Earth from the moon by the Apollo 12, 15 and 17

missions, as well as six volcanic rocks from the Earth's mantle -- five from Hawaii and one from Arizona.

The key to reconstructing the giant impact was a chemical signature revealed in the rocks' oxygen atoms. (Oxygen makes up 90 percent of rocks' volume and 50 percent of their weight.) More than 99.9 percent of Earth's oxygen is O-16, so called because each atom contains eight protons and eight neutrons. But there also are small quantities of heavier oxygen isotopes: O-17, which has one extra neutron, and O-18, which has two extra neutrons. Earth, Mars and other planetary bodies in our solar system each has a unique ratio of O-17 to O-16 -- each one a distinctive "fingerprint."

In 2014, a team of German scientists reported in *Science* that the moon also has its own unique ratio of oxygen isotopes, different from Earth's. The new research finds that is not the case.

"We don't see any difference between the Earth's and the moon's oxygen isotopes; they're indistinguishable," said Edward Young, lead author of the new study and a UCLA professor of geochemistry and cosmochemistry.

Young's research team used state-of-the-art technology and techniques to make extraordinarily precise and careful measurements, and verified them with UCLA's new mass spectrometer.

The fact that oxygen in rocks on the Earth and our moon share chemical signatures was very telling, Young said. Had Earth and Theia collided in a glancing side blow, the vast majority of the moon would have been made mainly of Theia, and the Earth and moon should have different oxygen isotopes. A head-on collision, however, likely would have resulted in similar chemical composition of both Earth and the moon.

"Theia was thoroughly mixed into both the Earth and the moon, and evenly dispersed between them," Young said. "This explains why we don't see a different signature of Theia in the moon versus the Earth."

Theia, which did not survive the collision (except that it now makes up large parts of Earth and the moon) was growing and probably would have become a planet if the crash had not occurred, Young said. Young and some other scientists believe the planet was approximately the same size as the Earth; others believe it was smaller, perhaps more similar in size to Mars.

Another interesting question is whether the collision with Theia removed any water that the early Earth may have contained. After the collision -- perhaps tens of millions of years later -- small asteroids likely hit the Earth, including ones that may have been rich in water, Young said. Collisions of growing bodies occurred very frequently back then, he said, although Mars avoided large collisions.

A head-on collision was initially proposed in 2012 by Matija uk, now a research scientist with the SETI Institute, and Sarah Stewart, now a professor at UC Davis; and, separately during the same year by Robin Canup of the Southwest Research Institute.

Co-authors of the *Science* paper are Issaku Kohl, a researcher in Young's laboratory; Paul Warren, a researcher in the UCLA department of Earth, planetary, and space sciences; David Rubie, a research professor at Germany's Bayerisches Geoinstitut, University of Bayreuth; and Seth Jacobson and Alessandro Morbidelli, planetary scientists at France's Laboratoire Lagrange, Université de Nice.

The research was funded by NASA, the Deep Carbon Observatory and a European Research Council advanced grant (ACCRETE).

Story Source: The above post is reprinted from materials provided by University of California – Los Angeles. The original item was written by Stuart Wolpert.

Journal Reference: E. D. Young, I. E. Kohl, P. H. Warren, D. C. Rubie, S. A. Jacobson, A. Morbidelli. **Oxygen isotopic evidence for vigorous mixing during the Moon-forming giant impact**. *Science*, 2016; 351 (6272): 493 DOI: 10.1126/science.aad0525

The Anthropocene: Hard evidence for a human-driven Earth

Earth (stock illustration).

Credit: © SkyLine / Fotolia

The evidence for a new geological epoch which marks the impact of human activity on Earth is now overwhelming, according to a recent paper by an international group of geoscientists. The Anthropocene, which is argued to start in the mid-20th Century, is marked by the spread of materials such as aluminum, concrete, plastic, fly ash and fallout from nuclear testing across the planet, coincident with elevated greenhouse gas emissions and unprecedented trans-global species invasions.

An international group of scientists is studying whether human activity has driven Earth into a new geological epoch -- the Anthropocene. They ask: to what extent are human actions recorded as measurable signals in geological strata, and is the Anthropocene world markedly different from the stable Holocene Epoch of the last 11,700 years that allowed human civilization to develop?

The Holocene Epoch has been a time during which human societies advanced by gradually domesticating the land to increase food production, built urban settlements, and became proficient at developing the water, mineral and energy resources of the planet. The proposed Anthropocene Epoch, however, is marked as a time of rapid environmental change brought on by the impact of a surge in human population and increased consumption during the 'Great Acceleration' of the mid-20th century.

Dr Colin Waters of the British Geological Survey said: "Humans have long affected the environment, but recently there has been a rapid global spread of novel materials including aluminum, concrete and plastics, which are leaving their mark in sediments. Fossil-fuel combustion has dispersed fly ash particles worldwide, pretty well coincident with the peak distribution of the 'bomb spike' of radionuclides generated by atmospheric testing of nuclear weapons." "All of this shows that there is an underlying reality to the Anthropocene concept," commented Jan Zalasiewicz of the University of Leicester, a co-author and working group Chair.

The study, co-authored by 24 members of the Anthropocene Working Group, shows that humans have changed the Earth system sufficiently to produce a range of signals in sediments and ice, and these are sufficiently distinctive to justify recognition of an Anthropocene Epoch in the Geological Time Scale. In 2016 the Anthropocene Working Group will gather more evidence on the Anthropocene, which will help inform recommendations on whether this new time unit should be formalized and, if so, how it might be defined and characterized.

A number of UK members of the group have contributed to this study, Colin Waters (lead author and Secretary of the group) and Michael Ellis, both from the British Geological Survey. Jan Zalasiewicz, Mark Williams and Matt Edgeworth from Leicester University and Colin Summerhayes from Cambridge University have provided significant input to this study and maintain the UK's strong involvement in research into the Anthropocene concept.

Story Source: The above post is reprinted from materials provided by University of Leicester.

Journal Reference: Colin N. Waters, Jan Zalasiewicz, Colin Summerhayes, Anthony D. Barnosky, Clément Poirier, Agnieszka Gałuszka, Alejandro Cearreta, Matt Edgeworth, Erle C. Ellis, Michael Ellis, Catherine Jeandel, Reinhold Leinfelder, J. R. McNeill, Daniel deB. Richter, Will Steffen, James Syvitski, Davor Vidas, Michael Wagreich, Mark Williams, An Zhisheng, Jacques Grinevald, Eric Odada, Naomi Oreskes, and Alexander P. Wolfe. **The Anthropocene is functionally and stratigraphically distinct from the Holocene**. *Science*, 2016: 351 (6269) DOI: 10.1126/science.aad2622

Catastrophic failure of South American Ice Age dam changed Pacific Ocean circulation and climate

Professor Neil Glasser.
Credit: Image courtesy of Aberystwyth University

The catastrophic release of fresh water from a vast south American lake at the end of the last Ice Age was significant enough to change circulation in the Pacific Ocean according to research published in the Nature journal *Scientific Reports* today, Friday 12 February 2016. The study, led by Professor Neil Glasser from Aberystwyth University, reveals that the lake, which was about one third the size of Wales, drained several times between 13,000 and 8,000 years ago, with devastating consequences.

At its high point the lake extended over 7,400 km^2, held 1500 km^3 of water and occupied a basin which now contains Lago General Carrera in Chile and Lago Buenos Aires in Argentina.

Held back by a dam formed by a large ice sheet, the lake drained rapidly as the ice sheet shrank in size.

Professor Glasser said: "This was a massive lake. When it drained, it released around 1150 km^3 of fresh water from the melting glaciers into the Atlantic and Pacific oceans -- equivalent to around 600 million Olympic-sized swimming pools. This had a considerable impact on the Pacific Ocean circulation and regional climate at the time."

"Much of the freshwater drained into the sea near Golfo Peñas, south of the Chilean capital Santiago. The fresh

water would have sat on top of the salt water as it spread out so that it affected the regional ocean currents. The event affected the whole of southern South America and would have led to lower rainfall in winter and cooler ocean and air temperatures around Cape Horn, with the effects felt as far east as the Falkland Islands."

"The study is important because we are currently concerned about the volumes of fresh water entering the oceans from the melting ice sheets in Greenland and Antarctica, and this gives us an indication of the likely effects."

The study was undertaken by scientists from Aberystwyth, Exeter, Stockholm and Reading Universities and the British Antarctic Survey, who applied different techniques to investigate the size of the former lake and how it drained.

Samples of sediments deposited by the former lake were collected to determine the age of the lake drainage events using a laboratory technique known as single-grain optically stimulated luminescence dating.

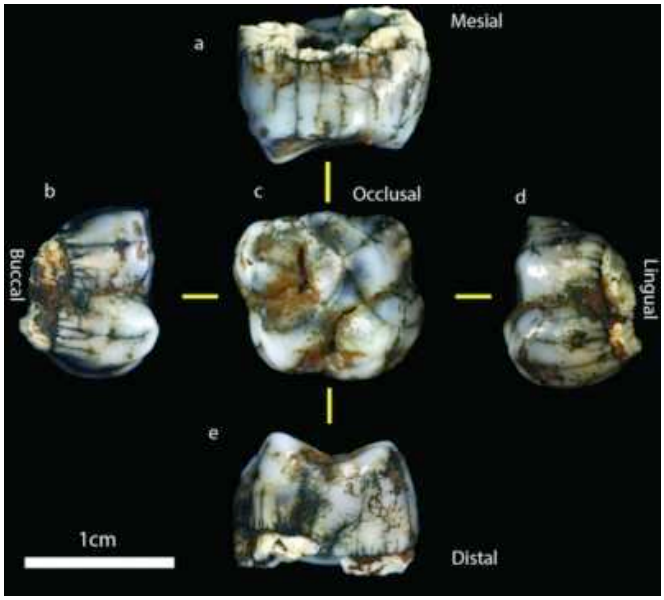
Digital Elevation Models (DEMs) were applied to identify former lake shorelines and their altitudes and drainage routes and to calculate the volume of water released as the lake drained. An ocean-atmosphere climate model was used to determine the impact of dumping this amount of freshwater into the Pacific Ocean.

Story Source: The above post is reprinted from materials provided by **Aberystwyth University**. *Note: Materials may be edited for content and length.*

Journal Reference: Neil F. Glasser, Krister N. Jansson, Geoffrey A. T. Duller, Joy Singarayer, Max Holloway, Stephan Harrison. **Glacial lake drainage in Patagonia (13-8 kyr) and response of the adjacent Pacific Ocean**. *Scientific Reports*, 2016; 6: 21064 DOI: 10.1038/srep21064.

South Africa's Sterkfontein Caves produce two new hominin fossils

Specimens from the Homo genus and can be associated with early stone tools dated to 2.18 million years ago



New homonin molar was found in Sterkfontein Caves. *Credit: Jason Heaton*

Two new hominin fossils have been found in a previously uninvestigated chamber in the Sterkfontein Caves, just North West of Johannesburg in South Africa. The two new specimens, a finger bone and a molar, are part of a set of four specimens, which seem to be from early hominins that can be associated with early stone tool-bearing sediments that entered the cave more than two million years ago.

"The specimens are exciting not only because they are associated with early stone tools, but also because they possess a mixture of intriguing features that raise many more questions than they give answers," says lead researcher Dr Dominic Stratford, a lecturer at the Wits School of Geography, Archaeology and Environmental studies, and research coordinator at the Sterkfontein Caves.

The first fossil specimen, which is a very large proximal finger bone, is significantly larger and more robust than any other hand bone of any hominin yet found in South African Plio-Pleistocene sites.

"It is almost complete and shows a really interesting mix of modern and archaic features. For example, the specimen is markedly curved -- more curved than *Homo naledi* and is similarly curved to the much older species *Australopithecus afarensis*," says Stratford.

The level of curvature is often linked to arborealism, but it lacks the strong muscle attachments that are expected to be present.

"The finger is similar in shape to the partial specimen from Olduvai Gorge that has been called *Homo habilis*, but is much larger. Overall, this specimen is unique in the South African plio-pleistocene fossil hominin record and deserves more studies," says Stratford.

The other fossil is a relatively small, nearly complete adult 1st molar tooth that also has striking similarities to species *Homo habilis*.

"In size and shape it also bears a resemblance to two of the 10 1st molars of the *H. naledi* specimens, although further and more detailed comparisons are needed to verify this."

The shape of the tooth and particularly the shape and relative sizes of the cones on the surface of the tooth suggest this specimen belonged to an early member of the *Homo* genus and can be associated with early stone tools dated recently to 2.18 million years ago.

"The two other hominin fossils found are still being studied and further excavations are planned to hopefully find more pieces and expand our understanding of whom these intriguing bones belonged to and how they lived and died on the Sterkfontein hill more than two million years ago," says Stratford.

The Sterkfontein Caves have been one of the most prolific palaeoanthropological sites in the world, since the discovery of the first ever adult *Australopithecus* by Robert Broom, 80 years ago this year. Since this incredible discovery, some of palaeoanthropology's most famous finds have come from the Sterkfontein Caves, including Ms. Ples and Little Foot.

Sterkfontein remains the richest *Australopithecus*-bearing locality in the world and continues to yield remarkable specimens. The underground network of caves at the site extends over 5 km and the caves are filled with fossiliferous sediments that have been deposited underground over a period of more than 3.67 million years.

However, very few of these deep deposits have been systematically excavated and so remain largely unknown. The Milner Hall, where the four new hominin fossils were found, is one such chamber where several large deposits have been identified but never excavated.

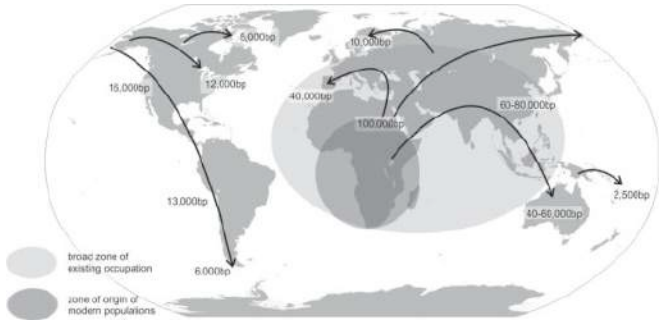
The excavations that yielded these new hominin fossils were being conducted as part of a new phase of exploratory excavations away from the known hominin-bearing areas. Excavations in the Jacovec Cavern, Name Chamber and Milner Hall have been started under Dr. Stratford's direction. Each has yielded exciting new fossils that shed further light on the story of our evolution and life on the Sterkfontein hill more than two million years ago.

During the second phase of excavation in the Milner Hall, which were started early in 2015 with student Kelita Shadrach, four hominin fossils were excavated from the upper layers of a long sequence of deposits that document the long history of fossil deposition in the cave, starting over 3.67 million years ago.

Story Source: The above post is reprinted from materials provided by University of the Witwatersrand.

Journal Reference: Dominic Stratford, Jason L. Heaton, Travis Rayne Pickering, Matthew V. Caruana, Kelita Shadrach. **First hominin fossils from Milner Hall, Sterkfontein, South Africa**. *Journal of Human Evolution*, 2016; 91: 167 DOI: 10.1016/j.jhevol.2015.12.005.

Betrayals of trust: Human nature's dark side may have helped us spread across the world



Dispersal pattern of humans after 100,000bp.
Credit: Image courtesy of University of York

New research by an archaeologist at the University of York suggests that betrayals of trust were the missing link in understanding the rapid spread of our own species around the world.

Dr Penny Spikins, of the University's Department of Archaeology, says that the speed and character of human dispersals changed significantly around 100,000 years ago.

Before then, movement of archaic humans were slow and largely governed by environmental events due to population increases or ecological changes. Afterwards populations spread with remarkable speed and across major environmental barriers.

But Dr Spikins, a senior lecturer in the Archaeology of Human Origins, relates this change to changes in human emotional relationships. In research published in *Open Quaternary*, she says that neither population increase nor ecological changes provide an adequate explanation for patterns of human movement into new regions which began around 100,000 years ago.

She suggests that as commitments to others became more essential to survival, and human groups ever more motivated to identify and punish those who cheat, the

'dark' side of human nature also developed. Moral disputes motivated by broken trust and a sense of betrayal became more frequent and motivated early humans to put distance between them and their rivals.

According to Dr Spikins, the emotional bonds which held populations together in crisis had a darker side in heartfelt reactions to betrayal which we still feel today. Larger social networks made it easier to find distant allies with whom to start new colonies, and more efficient hunting technology meant that anyone with a grudge was a danger but it was human emotions which provided the force of repulsion from existing occupied areas which we do not see in other animals.

Early species of hominin were limited in distribution to specific environments such as grasslands and open woodland. The expansion of Homo erectus out of Africa into Asia around 1.6 million years ago appears to have been caused by the need to find more large scale grasslands. By contrast, Neanderthals occupied cold and arid parts of Europe. All archaic species adapted slowly to new opportunities for settlement and were often deterred by environmental and climatic barriers.

After 100,000 years ago, however, dispersal into distant, risky and inhospitable areas became relatively more common compared with movements into already occupied regions. Most notably, the spread of modern human populations was not inhibited by biogeographical barriers. Populations moved into cold regions of Northern Europe, crossed significant deltas such as the Indus and the Ganges, deserts, tundra and jungle environment and even made significant sea crossings to reach Australia and the Pacific islands.

Dr Spikins argues that betrayals of trust resulting from moral disputes were a significant reason for such risky dispersals into apparently unwelcoming environments with a desire to avoid physical harm from disgruntled former friends and allies being a key motivation. Offenders and any allies within their social network would feel driven to get out of harm's way.

She says: "Active colonisations of and through hazardous terrain are difficult to explain through immediate pragmatic choices. But they become easier to explain through the rise of the strong motivations to harm others even at one's own expense which widespread emotional commitments bring.

"Moral conflicts provoke substantial mobility -- the furious ex ally, mate or whole group, with a poisoned spear or projectile intent on seeking revenge or justice, are a strong motivation to get away, and to take almost any risk to do so.

"While we view the global dispersal of our species as a symbol of our success, part of the motivations for such movements reflect a darker, though no less 'collaborative', side to human nature."

Story Source: The above post is reprinted from materials provided University of York.

Journal Reference: Penny Spikins. **The Geography of Trust and Betrayal: Moral disputes and Late Pleistocene dispersal**. *Open Quaternary*, 2015; DOI: 10.5334/oq.ai

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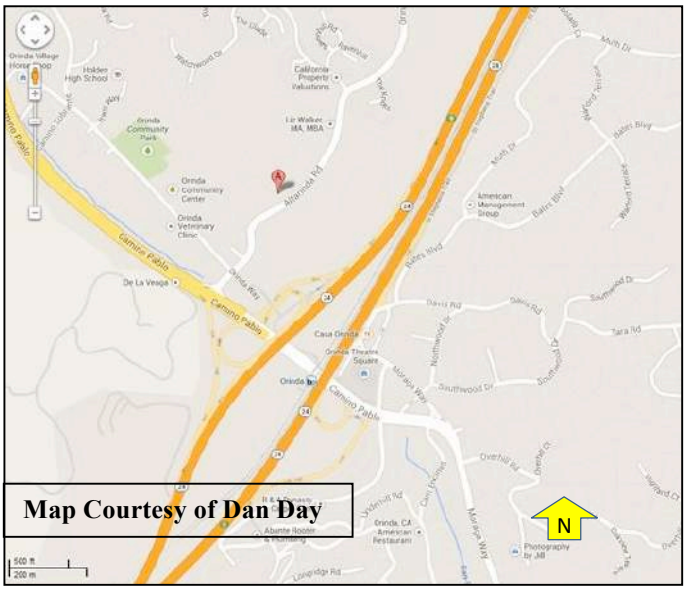

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