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## ARTIGO DA SEMANA

### Dark Matter

by [Ian O'Neill](#), Discovery News | February 27, 2015 02:21pm ET

[http://www.space.com/28601-supermassive-black-holes-dark-matter.html?cmpid=514630\\_20150302\\_41274006&adbid=10152668744416466&adbpl=fb&adbpr=17610706465](http://www.space.com/28601-supermassive-black-holes-dark-matter.html?cmpid=514630_20150302_41274006&adbid=10152668744416466&adbpl=fb&adbpr=17610706465)



This illustration shows two spiral galaxies -- each with supermassive black holes at their center -- as they are about to collide and form an elliptical galaxy. New research shows that galaxies' dark matter halos influence these mergers and the resulting growth of supermassive b

Credit: NASA/CXC/M. Weiss

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It has long been assumed that the size of a supermassive black hole in a galaxy's core is intimately related to the number of stars that galaxy contains — but it might not be that simple after all.

### [VIDEO: What if the Big Bang Never Happened?](#)

Every galaxy is cocooned inside a massive halo of [dark matter](#), the invisible stuff that is thought to account for nearly 85 percent of all matter in the universe. The bigger the galaxy, the bigger the dark matter halo. The stars that we observe in any given galaxy accounts for a tiny fraction of the total mass of that galaxy — the halo can extend for hundreds of thousands of light years from the visible galaxy's 'edge.'

The visible stars and gas in a galaxy can therefore be thought of as just the 'hub' of that galaxy; the rest of the 'wheel' extends far into intergalactic space, but as it is composed of dark matter, which does not interact with electromagnetic radiation (light), it cannot be seen. [[Gallery: The Search for Dark Matter](#)]

Although astronomers have known about these halos for some time, their gravitational impact on the visible stuff (stars, planets, gas) inside their host galaxies is poorly understood. And now dark matter's impact on black hole evolution is under scrutiny.

#### ANALYSIS: Did 'Dark Stars' Spawn Supermassive Black Holes?

"There seems to be a mysterious link between the amount of dark matter a galaxy holds and the size of its central black hole, even though the two operate on vastly different scales," said lead author Akos Bogdan of the Harvard-Smithsonian Center for Astrophysics (CfA), Cambridge, Mass. Bogdan's work, co-authored with Andy Goulding (of Princeton University), has been accepted for publication in *The Astrophysical Journal*.

The majority of galaxies are thought to contain a supermassive black hole in their cores and, by studying over 3,000 elliptical galaxies, Bogdan and Goulding gauged the masses of their monster black holes by clocking the speeds of the stars whizzing around the central black holes.

Then, to measure the total mass of dark matter those galaxies possessed, the researchers observed the X-rays generated by the hot gas the galaxies contained. The more hot gas the galaxy has, the more massive its halo.

#### ANALYSIS: Black Holes as Exotic Particle Honeypots?

With this information in hand, the researchers were able to deduce that there is a strong relationship between the amount of [halo dark matter](#) and mass of the central black hole. This dark matter correlation is much stronger than the relationship between the number of stars and black hole mass.

As elliptical galaxies are products of galactic mergers — i.e. many galaxies clumping together over billions of years — the final elliptical is not only composed of many galaxies-worth of stars, but also a reservoir of all the dark matter those galaxies contained. Dark matter therefore has the dominant gravitational impact, dominating galactic evolution and guiding black hole growth.

"In effect, the act of merging creates a gravitational blueprint that the galaxy, the stars and the black hole will follow in order to build themselves," said Bogdan.

Source: [CfA press release](#)

This article was provided by [Discovery News](#).

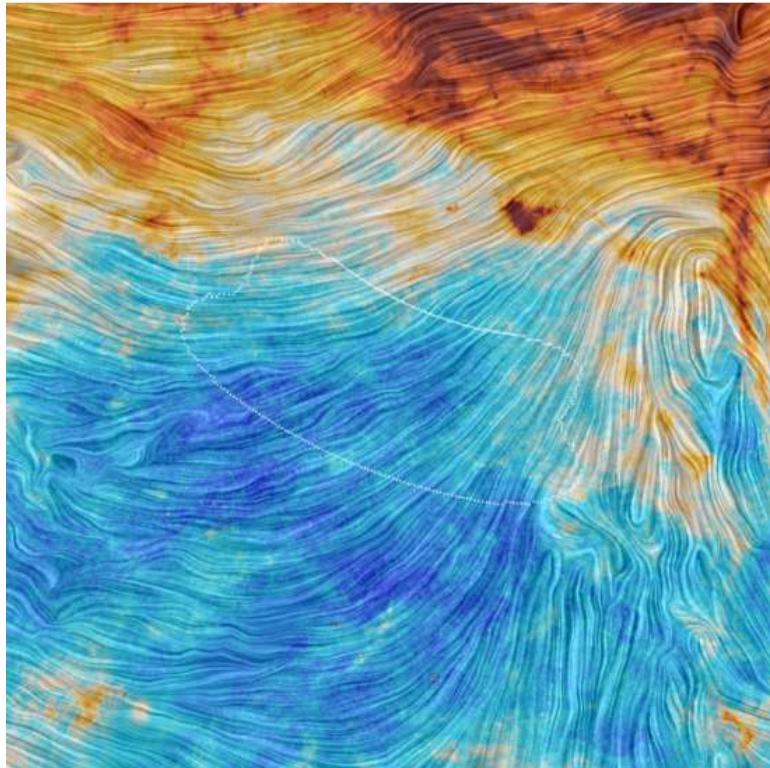
## NEWS METEORITICA DA SEMANA

<https://netnature.wordpress.com/2015/03/02/ondas-gravitacionais-descobertas-estao-oficialmente-mortas/>

### **ONDAS GRAVITACIONAIS DESCOBERTAS ESTÃO OFICIALMENTE MORTAS.**

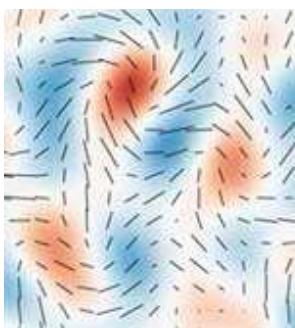
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**Dados combinados do Pólo Sul no experimento BICEP2 e dados de Planck para a poeira Galáctica causam confusão. A divulgação foi feita como TREMORES DO BIG BANG: PRIMEIRA EVIDÊNCIA DIRETA DE INFLAÇÃO CÓSMICA**



A região do céu onde o telescópio BICEP2 observou a polarização das microondas, mostradas como linhas pontilhadas sobre dados de Planck.

Uma equipe de astrônomos que no ano passado relataram evidências de ondas gravitacionais do início do Universo perdeu seu posto. A análise conjunta dos dados registrados pelo grupo do telescópio BICEP2 no Pólo Sul e pela nave espacial europeia Planck revelou que o sinal pode ser totalmente atribuído a poeira da Via Láctea ao invés de ter uma mais antiga, de origem cósmica.



Nature: [Ondas do Big Bang](#)

A Agência Espacial Europeia (ESA) anunciou os resultados há muito tempo aguardado (em 30 de janeiro), um dia depois de um resumo do que tinha sido inadvertidamente publicado on-line por membros franceses da equipe satélite de Planck e, em seguida, amplamente divulgado antes de ter sido retirado.

A constatação de março 2014 foi lançada por pesquisadores que operam um rádio telescópio no Pólo Sul chamado BICEP2. O resultado dependia da descoberta de um padrão na polarização da radiação cósmica de fundo, uma radiação relíquia do Big Bang. A equipe atribuiu o padrão de ondas gravitacionais – ondulações no espaço-tempo – gerados durante o início do Universo, quando os cosmólogos acreditam que o cosmos foi submetido a um breve, mas tumultuado episódio de expansão conhecida como a inflação. Caso seja detectado, as ondas primordiais confirmaria a teoria altamente bem sucedida, mas não foi comprovada inflação.

A poeira da Via Láctea também emite luz polarizada que pode ter o mesmo padrão e imprimiu-o nas ondas. Os astrônomos tinham sugerido várias vezes durante o ano passado que a equipe BICEP2 estava sendo enganada por esse sinal Galáctico (veja "[mapa poeira atrapalha busca por ondas gravitacionais](#)"). A análise Planck-BICEP2 confirma que BICEP2 não pode afirmar ter visto evidências de ondas gravitacionais primordiais.

#### Tudo para baixo da poeira

Na análise conjunta, os pesquisadores sobrepuçaram dados registrados pelo telescópio BICEP2 a uma frequência de 150 gigahertz (GHz), com dados gravados a partir do mesmo fragmento do céu estudado por Planck em 353 GHz, a freqüência em que quase toda a luz polarizada vem da poeira. (Planck também registra sinais de polarização em freqüências mais baixas). Os dois conjuntos de dados se combinaram – a região em que BICEP2 encontrou no seu sinal mais forte é o mesmo lugar em que o sinal da poeira é mais forte, o que indica que o sinal BICEP2 é devido quase que inteiramente à poeira.

"Este trabalho conjunto tem mostrado que a detecção de B-modes primordiais não é mais robusta uma vez que a emissão de poeira galática é removida", diz o astrônomo Jean-Loup Puget, da Universidade de Paris-Sud, em Orsay na liberação ESA imprensa. "Então, infelizmente, não temos sido capazes de confirmar que o sinal é uma marca da inflação cósmica."

"Eu já não acreditava que BICEP2 havia detectado o sinal de ondas gravitacionais", diz Marc Kamionkowski cosmólogo da Universidade Johns Hopkins, em Baltimore, Maryland, que não é membro de qualquer equipe.

O pesquisador George Efstathiou, da Universidade de Cambridge, Reino Unido, diz que a conclusão não é nenhuma surpresa. "Eu não sei por que as pessoas estão tão animadas", diz ele. "Não há nada de dramático aqui, do ponto de vista da ciência."

#### Vazamento "infeliz"

Efstathiou caracterizou em 29 de janeiro o vazamento um tanto quanto "lamentável" e "descuidado". "O pessoa do BICEP2 sentiu que não tinha tratado certo a publicidade da primeira vez" e que todos estavam ansiosos para tornar pública a análise conjunta de uma forma mais cautelosa.

O cosmólogo Raphael Flauger da Carnegie Mellon University, em Pittsburgh, Pensilvânia, que foi um dos primeiros pesquisadores a questionar os resultados BICEP2, concorda com esse ponto de vista. "É um pouco lamentável que tal um resultado tão aguardado foi apresentado ao público desta maneira", observa ele. Ele se recusou a discutir os detalhes da análise conjunta porque o [paper](#) ainda não estava disponível, mas ele observou que "o que está claro a partir desses lotes é que os níveis de poeira foram subestimados nos resultados apresentados em março pelo BICEP2, de acordo com o que foi dito em [nossa paper](#)" (veja a [descoberta de ondas gravitacionais enfrenta escrutínio](#)).

"Quando detectado pela primeira vez este sinal em nossos dados, contamos com modelos para as emissões de poeira que estavam disponíveis no momento", diz John Kovac, um investigador principal BICEP2 no Centro Harvard-Smithsonian de Astrofísica, em Cambridge, Massachusetts, em o lançamento ESA imprensa. "Estes parecem indicar que a região do céu escolhida para as nossas observações tiveram a polarização da poeira muito mais baixo do que o sinal detectado".

As últimas descobertas não significam que seja impossível encontrar provas de ondas gravitacionais da radiação cósmica de fundo – só que BICEP2 não poderia de forma conclusiva detectar um sinal em meio ao barulho galático.

"Há um caminho claro para a frente", diz Kamionkowski. "Se fizermos mais medidas desse tipo em múltiplas freqüências, seremos capazes de separar o sinal de poeira a partir do sinal [primordial] precisamente" e fazer uma esquise mais aprofundada para ondas gravitacionais.

**Fonte:** [Nature](#)

## **AMBIENTE BRASIL**

### **06 / 03 / 2015 Descoberto fóssil humano mais antigo com 2,8 milhões de anos**

A mandíbula do lado esquerdo da boca estava na área de pesquisa Ledi-Geraru (entre os rios Awash e Ledi), no estado de Afar, nordeste da Etiópia.

### **06 / 03 / 2015 Província chinesa fecha siderúrgicas em guerra contra poluição**

Fechamentos de usinas ocorreram na província de Shangdong. Premiê do país disse nesta quinta que vai travar guerra contra a poluição.

### **06 / 03 / 2015 Filhotes de passáro 'viram' lagartas para espantar predadores**

Laniocera hypopyrra, mais conhecida como chorona-cinza, tem uma forma de 'camuflar' seus filhotes. A penugem dos filhotes "transforma" os filhotinhos em "clones" de uma lagarta venenosa que vive na região, a Podalia.

### **06 / 03 / 2015 SP contestará ação sobre volume útil preservado no Cantareira, diz Alckmin**

Liminar determina que sistema tenha 10% do volume original até estiagem. 'Não há razão para judicialização', defendeu governador em Jaguariúna (SP).

### **06 / 03 / 2015 Astrônomos descobrem planeta gigante com quatro sóis**

Além de ser o segundo planeta com quatro sóis que se tem notícia, este chamou a atenção dos astrônomos por não apresentar uma superfície real, ou seja, sem um núcleo sólido.

### **06 / 03 / 2015 Rio Juruá sai da cota de transbordo em Cruzeiro do Sul/AC**

Energia será religada em cinco bairros quando rio chegar a menos de 12m. Famílias devem voltar para suas casas no início de abril, dizem Bombeiros.

### **06 / 03 / 2015 Chile confirma que há relação entre esfriamento da Terra e fim de dinossauros**

Os fósseis da flora e da fauna encontrados na Região de Magalhães, no extremo sul do Chile, revelam a existência de um esfriamento do clima durante o fim do período Cretáceo da Era Mesozóica o que "favoreceu a extinção dos dinossauros".

### **06 / 03 / 2015 Primeiro-ministro da China promete lutar contra poluição e corrupção**

Li Keqiang chamou poluição de 'chaga sobre a qualidade de vida'. Ele disse ainda que vai reforçar a fiscalização em seu governo.

### **06 / 03 / 2015 EUA confirma que El Niño chegou, mas tardio e enfraquecido**

Devido ao enfraquecimento do fenômeno, "não estão previstos" efeitos generalizados ou grandes do El Niño, mas sim condições mais úmidas do que o normal durante a primavera no litoral do Golfo dos Estados Unidos.

### **06 / 03 / 2015 Sem chuva, Rio Piracicaba fica 69% abaixo da média e pedras reaparecem**

Volume de água nesta quinta-feira (5) está em 52,43 mil litros por segundo. Vazão média para março, entretanto, é de 168 mil litros, conforme o Daae.

### **06 / 03 / 2015 Vacina contra o ebola começará a ser testada em 7 de março na Guiné**

Testes clínicos serão com a vacina VSV-ZEBOV, desenvolvida no Canadá. Patente foi adquirida pela empresa farmacêutica Merck.

### **06 / 03 / 2015 Sobe para 355 o número de casos de dengue registrados em SC no ano**

Do total, 285 foram resultado de transmissão dentro do próprio estado. Município de Itajaí, no Vale, concentra o maior número de pacientes.

### **06 / 03 / 2015 Mananciais que abastecem São Paulo estão com nível estável**

Nesses cinco dias de março, a pluviometria do Cantareira está em apenas 3,7 milímetros (mm). O volume esperado para todo o mês é de 178 mm. Mais quatro mananciais estão com o armazenamento estável: Alto Tietê (18,9%); Guarapiranga (63%); Rio Grande (85,4%) e Rio Claro (38,5%).

### **06 / 03 / 2015 Extração ilegal de madeira ainda é realidade no Brasil, aponta estudo inédito do FSC**

Segundo o estudo, praticamente todos os estados brasileiros apresentaram taxas de desmatamento acima de 100 km<sup>2</sup> anuais nos últimos anos.

### **06 / 03 / 2015 Libéria anuncia que já não tem doentes com ebola**

Último paciente em tratamento recebeu alta nesta quinta na capital do país. Mais de 23.900 casos foram confirmados; 9.800 pessoas morreram.

## **06 / 03 / 2015 Por que o peso de um dinossauro importa para a ciência**

Cientistas britânicos determinaram que espécie de estegossauro pesava 1,6 tonelada e tinha o tamanho de um rinoceronte, descoberta que abre caminho para novos estudos.

## **05 / 03 / 2015 Árvores da Amazônia consomem menos carbono em épocas de seca**

Queda de consumo de carbono aumenta mortes de árvores, diz estudo. Decomposição de árvores eleva CO<sub>2</sub>, acelerando mudanças climáticas.

## **05 / 03 / 2015 Fóssil antecipa em 400 mil anos a origem da espécie humana**

Mandíbula de 2,8 milhões de anos é fóssil mais antigo do gênero Homo. Fósseis encontrados em 2013 na Etiópia.

## **05 / 03 / 2015 No Amazonas, 3,5 mil filhotes de quelônios são soltos na natureza**

Ação aconteceu em duas cidades na segunda quinzena de fevereiro. Mais de 300 mil filhotes ainda serão soltos em comunidades do AM e PA.

## **05 / 03 / 2015 Austrália sacrifica cerca de 700 coalas para conter superpopulação**

Excesso de animais no estado de Vitória causa problemas, diz governo. Apesar do abate, o coala é uma espécie ameaçada de extinção no país.

## **05 / 03 / 2015 Cientistas concluem teste de remédio que promete curar alcoolismo**

Pesquisadores da Rússia usaram princípio ativo que controla convulsões. Testes com roedores apresentaram resultados promissores.

## **05 / 03 / 2015 Adultos têm em média só uma gripe de verdade a cada 5 anos, diz estudo**

Pesquisadores dizem que crianças são atingidas por infecções com mais frequência; 'existe muita confusão entre resfriados e gripe', diz um especialista.

## **05 / 03 / 2015 Em visita à China, príncipe William pede fim do comércio de marfim**

Herdeiro do trono britânico visitou santuário de elefantes em Yunnan. China anunciou proibição de 1 ano da importação de esculturas de marfim.

## **05 / 03 / 2015 Inundações na Argentina deixam um morto e milhares de desabrigados**

As inundações atingem Córdoba, San Luis, Santiago del Estero e Santa Fé, uma zona de agricultura e pecuária que responde por um grande volume de exportação de alimentos.

## **05 / 03 / 2015 Ararinhas-azuis nascidas na Alemanha chegam ao Brasil**

De acordo com o Ministério do Meio Ambiente, atualmente existem apenas 11 animais da espécie no País.

## **05 / 03 / 2015 Nível do Cantareira fica estável e dois mananciais de São Paulo têm queda**

As captações de chuva acumulam neste mês de março 2,1 milímetros (mm) – abaixo do volume registrado em igual período do mês passado (44 mm). A média histórica para este mês é 178 mm.

## **05 / 03 / 2015 Cientista brasileira que estuda buracos negros ganha prêmio da ONU**

Thaisa Bergmann, professora em Porto Alegre, foi escolhida pela Unesco. Premiação reconhece mulheres que contribuíram para o avanço científico.

## **05 / 03 / 2015 Nanossatélite brasileiro de R\$ 400 mil é declarado inoperante após falha**

Falha na abertura da antena de telemetria impediu funcionamento do satélite. Cubesat foi feito por equipes do Inpe e do ITA, em São José dos Campos.

## **05 / 03 / 2015 Governo peruano supervisoria vazamento de 200 barris de petróleo na Amazônia**

O vazamento aconteceu no último dia 24 em um oleoduto da empresa argentina Pluspetrol, que tem autorização de exploração até 2024.

## **05 / 03 / 2015 Governo define calendário para declaração de emergência ambiental**

A medida considera o limite de contratação temporária de brigadistas para o atendimento de emergências ambientais.

## **05 / 03 / 2015 Lixo e risco de fuga de animais podem fechar zoo do Rio**

Ministério Público deu 30 dias à Prefeitura para começar as obras aprovadas em 2014 e paradas até hoje.

## **05 / 03 / 2015 Defesa Civil decreta calamidade pública em Rio Branco e Brasileia, no Acre**

Em nota, o Ministério da Integração explica que as duas cidades já viviam situação de emergência, mas a mudança permite que o governo local solicite recursos da União para ações de socorro, assistência às vítimas, restabelecimento de serviços essenciais e reconstrução.

## **04 / 03 / 2015 Abelhas invadem áreas verdes dos aeroportos**

Um projeto que busca agregar créditos verdes permitiu a instalação de colmeias em espaços vazios de aeroportos.

## **04 / 03 / 2015 Vazão da Barragem Santa Cecília será reduzida gradualmente**

A redução da vazão mínima de Santa Cecília, de 140 metros cúbicos por segundo para 110, foi determinada na segunda-feira (2) pela Agência Nacional de Águas.

## **04 / 03 / 2015 'Beefalo': o híbrido de vaca e bisão que ameaça o Grand Canyon**

Animal nasceu de experiência malsucedida no início do século 20 e agora traz riscos à famosa reserva natural nos Estados Unidos.

## **04 / 03 / 2015 DF recebe cem militares do Exército para combater dengue e chikungunya**

Treinamento ocorre até a próxima sexta-feira (6). Homens reforçarão 17 equipes; doenças têm mesmo mosquito como vetor.

## **04 / 03 / 2015 Elefante de apenas três pernas recebe nova prótese na Tailândia**

Mosha perdeu parte de uma das pernas ao pisar em uma mina em 2006. Esta é a quinta prótese que ela recebe ao longo da vida.

## **04 / 03 / 2015 ONG põe Brasil em lista de sistemas de saúde vulneráveis a epidemias**

Estudo tenta conscientizar sobre crises como a do ebola, que matou milhares. Brasil tem o melhor atendimento entre os 72 países analisados pela ONG.

## **04 / 03 / 2015 Alertas de desmatamento crescem 90,5% na Amazônia Legal**

A área afetada subiu de 1.162,7 quilômetros quadrados (km<sup>2</sup>) para 2.215,5 km<sup>2</sup>.

## **04 / 03 / 2015 Pesquisa liga café diário a artérias mais limpas**

Segundo pesquisadores sul-coreanos, consumo moderado de café está relacionado a menor possibilidade de doença cardíaca.

## **04 / 03 / 2015 MMA prorroga as inscrições no programa de economia energética**

Chamada aberta até 30 de março traçará o perfil dos gastos em prédios governamentais.

## **04 / 03 / 2015 Britânicos projetam lagoas artificiais geradoras de energia**

Plano é construir grandes muros em áreas costeiras e aproveitar energia das marés.

## **04 / 03 / 2015 Tubarão 'alienígena' é capturado e exposto em museu australiano**

Esqueleto foi capturado por um pescador na costa sudeste australiana. Espécie está presente nos oceanos Pacífico, Atlântico e Índico.

## **04 / 03 / 2015 Vulcão Villarica entra em erupção no Sul do Chile**

A presidente Michelle Bachelet convocou os ministros do Interior, da Defesa e da Saúde para reunião de emergência, com o objetivo de coordenar as medidas de prevenção para contornar o problema.

## **04 / 03 / 2015 Comer amendoim com frequência faz bem para o coração, sugere estudo**

Produto diminui mortalidade por doença cardíaca entre 17% e 21%. Pesquisa foi feita com 200 mil pessoas dos EUA e da China.

## **04 / 03 / 2015 Em 15 anos, Colômbia perde 608 mil hectares de floresta por semeadura de coca**

O estudo "Coca: Desmatamento, contaminação e pobreza", que foi elaborado pelo departamento Antinarcóticos da Polícia, com apoio do Centro Internacional de Estudos Estratégicos contra o Tráfico de Drogas, faz um balanço dos impactos que os cultivos ilícitos tiveram na Colômbia do ponto de vista ambiental.

## **03 / 03 / 2015 Desmate na Amazônia Legal sobe 40% entre novembro e janeiro, diz Inpe**

Floresta amazônica perdeu 219 km<sup>2</sup> de área no trimestre entre 2014 e 2015. Dados sobre desflorestamento foram obtidos pelo sistema Deter.

## **03 / 03 / 2015 China manda governos locais punirem usinas siderúrgicas poluidoras**

Treze de 15 empresas fiscalizadas na cidade de Linyi violaram leis ambientais. A maior parte são usinas de aço e carvão coque, com

algumas tendo fornecido dados ambientais falsos.

### **03 / 03 / 2015 Incêndios florestais na Argentina foram intencionais**

Os incêndios florestais que afetam mais de 20.000 hectares de floresta nativa na Patagônia foram iniciados intencionalmente para fins de exploração imobiliária.

### **03 / 03 / 2015 Crânio encontrado pode ser de linhagem humana desconhecida**

A descoberta de 22 mil anos possui características diferentes de todos os ancestrais conhecidos.

### **03 / 03 / 2015 Bactéria letal é detectada na parte externa de laboratório de segurança**

Segundo jornal, bactéria foi encontrada em laboratório na Louisiana. Local trabalha em uma vacina contra o 'Burkholderia pseudomallei'.

### **03 / 03 / 2015 Duas novas espécies de aranha-pavão são descobertas**

Ambas foram descobertas e apelidadas por Madeline Girard, da Universidade da Califórnia, em Berkeley (EUA).

### **03 / 03 / 2015 Avião Solar Impulse realiza voo teste e se prepara para volta ao mundo**

Com a nova façanha, os cofundadores suíços do projeto, Bertrand Piccard e André Borschberg, querem demonstrar que as tecnologias limpas e as energias renováveis permitem conseguir coisas consideradas até agora impossíveis.

### **03 / 03 / 2015 Fevereiro foi mês mais chuvoso no Cantareira desde 1995, diz Sabesp**

Precipitação registrada no mês passado foi de 322,4 mm. Na segunda-feira (2), as represas do sistema operavam a 11,7%.

### **03 / 03 / 2015 Cheia faz subir para sete número de cidades em emergência no Amazonas**

Boca do Acre entrou em lista no fim de semana, diz Defesa Civil. Em todo o estado, 11 famílias estão sendo afetadas.

### **03 / 03 / 2015 Na era do gelo, o frio dizimou os pinguins imperadores da Antártica**

População dessas aves pinguins aumentou quando temperatura subiu 15°C. Estudo foi publicado na revista 'Global Change Biology'.

### **03 / 03 / 2015 Carga de madeira ilegal é apreendida pela PRF em Dom Eliseu, no Pará**

Motorista de caminhão apresentou documentos adulterados da carga. Madeira foi embarcada em Ulianópolis e teria como destino o Maranhão.

### **03 / 03 / 2015 Com elevação dos reservatórios, usinas no Rio Paraíba do Sul voltam a operar**

Além das chuvas, que contribuíram para o aumento do nível, a vazante foi reduzida na comparação com a época em que os reservatórios atingiram o nível mais baixo.

### **03 / 03 / 2015 GPS não funciona? Pode ser culpa das irregularidades da atmosfera da Terra**

Um novo estudo, publicado na revista Geophysical Research Letters, compara a turbulência na região das auroras boreais com as latitudes mais altas, e os ganhos de percepções que podem ter as implicações que amenizam os distúrbios na ionosfera. As auroras são luzes multicoloridas no céu, que ocorrem principalmente quando partículas energéticas expulsas da magnetosfera, a bolha magnética protetora que envolve a Terra, colidem com a ionosfera.

### **03 / 03 / 2015 Projeto usa 'Aedes do Bem' para combater o mosquito da dengue**

Piracicaba (SP) contratou empresa que modifica geneticamente inseto. Até 2 milhões de machos 'transgênicos' serão soltos por semana.

### **03 / 03 / 2015 Dados mundiais de satélite indicam que desmatamento está acelerando**

Entre 1990 e 2000, taxa anual de desmate foi de 4 milhões de hectares. Estudo questiona dados da ONU que indicam diminuição no desmatamento.

### **03 / 03 / 2015 Suíça é o primeiro país a entregar plano climático para acordo da ONU**

Governos têm até 31/3 para apresentar metas contra emissões após 2020. Países crirão novo tratado que tentará frear aumento da temperatura.

### **02 / 03 / 2015 Rebanhos e queima de biomassa contribuem para emissão de metano na Amazônia**

A estimativa é da bióloga Luana Basso, em pesquisa para o Instituto de Pesquisas Energéticas e Nucleares (Ipen), entidade associada à USP.

### **02 / 03 / 2015 Google Street View lança 2ª etapa de imagens para visita virtual à Amazônia**

Mais de 500 Km de rios, lagos e floresta foram percorridos durante trabalho. Comunidades do interior do AM sugeriram locais para

captura de imagens.

## **02 / 03 / 2015 [Falta de recursos ameaca perpetuar cólera no Haiti, alerta ONU](#)**

Surto de cólera que atinge o país desde 2010 continua a ser uma ameaça. Nos últimos meses, casos aumentaram para 5 mil por mês, diz ONU.

## **02 / 03 / 2015 [População de pandas gigantes aumenta na China](#)**

Segundo estudo, número cresceu 17% em dez anos. 1.864 pandas gigantes viviam na China em estado selvagem em 2013.

## **02 / 03 / 2015 [Índia reconhece 965 mortos por gripe suína e problemas em diagnóstico](#)**

A incidência do H1N1 está sendo de forma incomum alta este inverno no país asiático.

## **02 / 03 / 2015 [Com mais de 5 mil atingidos pela cheia, Rio Branco/AC decreta calamidade](#)**

Campanha 'Acre Solidário' reforça pedido de doações aos desabrigados. Bairros mais atingidos são: 6 de Agosto, Baixada do Habitasa e Taquari.

## **02 / 03 / 2015 [Pesquisa aponta que 90% dos focos de dengue estão nas residências](#)**

Moradores devem ficar atento com vasos e pratos de plantas no quintal. Métodos alternativos podem ser usados no combate do foco do mosquito.

## **02 / 03 / 2015 [Produção de grãos pode chegar a 37 milhões de toneladas no Paraná](#)**

Crescimento é de 2% em comparação à safra anterior, segundo a Seab. Previsão leva em conta as três safras plantadas no ano agrícola 2014/2015.

## **02 / 03 / 2015 [Hércules da FAB segue na Antártica três meses após pousar de barriga](#)**

Aeronave ficou danificada em acidente e não pode voar sem conserto. FAB não tem previsão de reparo ou desmanche; tratado proíbe deixá-la lá.

## **02 / 03 / 2015 [Após 'EI' destruir antiguidades, Iraque reabre museu fechado desde 2003](#)**

Reabertura ocorreu como resposta ao ataque; cerca de um terço das 15 mil peças levadas de Bagdá foram recuperadas.

## **02 / 03 / 2015 [Astronautas americanos completam terceira caminhada espacial](#)**

Preso à parte externa da estação orbital, o comandante da ISS, Barry Wilmore e o engenheiro de voo Terry Virts completaram suas tarefas em cinco horas e 38 minutos, aproximadamente uma hora antes do previsto.

## **02 / 03 / 2015 [Indígenas recebem orientação sobre descarte correto de lixo em Roraima](#)**

Ação ocorre em 12 comunidades indígenas da capital e no interior do estado. Mais de 3 mil toneladas de lixo foram recolhidas durante o ano de 2014.

## **02 / 03 / 2015 [Nova York/EUA espera outra tempestade de neve após fevereiro mais frio em décadas](#)**

Embora não sejam esperadas grandes precipitações, as autoridades da cidade deram no sábado (28) um alerta e começaram a jogar sal pelas ruas, que em muitas partes da Big Apple ainda estão ainda cobertas por neve e gelo de tempestades anteriores.

## **02 / 03 / 2015 [Necrópole milenar é encontrada nos arredores de Pequim](#)**

Grande complexo funerário tinha 129 túmulos. Eles pertencem às dinastias Han Oriental, Tang e Liao.

## **02 / 03 / 2015 [ONGs inscrevem projetos inovadores de combate à dengue](#)**

A iniciativa objetiva encontrar planos que possam ser aplicados no Brasil e em outros países latino-americanos.

## **02 / 03 / 2015 [Aves silvestres são resgatadas pela PM em feira de João Pessoa/PB](#)**

Operação da Polícia Militar aconteceu na Feira de Oitizeiro. Golado, galo de campina, azulão e papa capim foram algumas das aves.

## **28 / 02 / 2015 [Dois aerogeradores são instalados na Torre Eiffel](#)**

Os aerogeradores, de sete metros de altura por três de largura, foram instalados no segundo piso, a 127 metros do chão, e têm uma capacidade de produção de 10.000 kwh anuais, isto é, o consumo energético da loja do primeiro andar.

## **28 / 02 / 2015 [Nasa apura vazamento de água em capacete de astronauta](#)**

Água vazou no capacete de um astronauta depois de uma caminhada espacial na quarta-feira (25).

**28 / 02 / 2015 [Ceará tem 54 casos de sarampo confirmados em 2015, diz secretaria](#)**

Outros 67 casos estão sendo investigados pela Secretaria de Saúde. Fortaleza concentra o maior número de casos em investigação.

**28 / 02 / 2015 [China proíbe importação de marfim esculpido durante um ano](#)**

Ação é resposta a críticas internacionais por demanda local pelo item. Retirada de marfim é responsável por massacre de elefantes.

**28 / 02 / 2015 [Cientistas avistam filhote de orca no litoral dos EUA](#)**

Foi o terceiro nascimento documentado na temporada. Espécie tem população pequena e está ameaçada.

**28 / 02 / 2015 [Nível do Cantareira fica estável em 11,1%](#)**

Depois de permanecer 21 dias consecutivos em alta, o nível do Sistema Cantareira ficou estável em 11,1% de quinta (26) para sexta-feira (27).

**28 / 02 / 2015 [Estátua de ouro de templo chinês carrega múmia de monge](#)**

A descoberta foi realizada depois de a estátua ser encaminhada para restauração, no final de 2014.

**28 / 02 / 2015 [Buraco negro 12 bilhões de vezes maior que Sol causa dúvidas](#)**

Novo buraco negro foi nomeado SDSS J0100+2802 se formou 900 milhões de anos após o "Big Bang", que teria dado origem ao universo.

**28 / 02 / 2015 ["Tartarugas saíram da UTI, mas estão no quarto, esperando alta", diz Tamar](#)**

Como tudo relacionado às tartarugas é lento, ainda vai demorar "uns bons anos" para a situação voltar ao normal - embora sejam devolvidas mais de dois milhões de tartarugas por ano ao mar, existem apenas 7.350 fêmeas desovando nas praias brasileiras, número considerado muito baixo, equivalente, por exemplo, ao de jovens mulheres que visitam o projeto por semana.

**28 / 02 / 2015 [Cães podem perceber quando pessoas estão os enganando](#)**

Pesquisa defende que os cães são capazes de fazer inferências sobre a confiabilidade de uma pessoa com base na experiência.

**28 / 02 / 2015 [Ministro visita regiões atingidas por cheia no Acre e promete ajuda](#)**

Ministro afirma que 17 mil kits serão enviados ao Acre. Enchentes afetam mais 83 mil pessoas no estado.

**28 / 02 / 2015 [Peru dá sinal verde para extraditar membro do Greenpeace](#)**

Grupo fez ação em Linhas de Nazca, patrimônio cultural da humanidade. Danos ao local foram constatados por perícia de arqueólogos.

**28 / 02 / 2015 [Ilha vulcânica japonesa "nasceu" em 2013 e não para de crescer](#)**

Segundo a rede de TV japonesa NHK, a ilha aumentou 11 vezes o seu tamanho inicial desde 2013. Uma cratera segue lançando matéria entre 5 e 6 vezes por dia.

**28 / 02 / 2015 [Cheia já afeta mais de 56 mil pessoas no AM, e Defesa Civil pede doações](#)**

Seis cidades do estado estão em situação de emergência. Oito municípios estão em atenção; órgão monitora situação.

### **23 / 02 / 2015 Vazamento de água radioativa é detectado na Central de Fukushima**

A situação foi observada por meio de sensores ligados a um tubo de drenagem de águas pluviais e subterrâneas, que mediram níveis de radioatividade até 70 vezes maiores do que outros valores já registrados no local.

### **23 / 02 / 2015 Cientistas buscam na Antártida a chave para o futuro da humanidade**

A Antártida "é grande e está mudando. Isso afeta o resto do planeta, e não podemos nos dar o luxo de fazer vista grossa ao que acontece lá", disse David Vaughan, diretor de ciência do Centro de Pesquisas da Antártida do Reino Unido.

### **23 / 02 / 2015 Projeto de preservação de nascentes é destaque em Muriaé/MG**

Renascer é uma parceria entre Prefeitura, IEF e Emater-MG. Desde julho de 2014, 20 nascentes já foram preservadas no município.

### **23 / 02 / 2015 Tamanho é documento: estudo mostra que animais crescem à medida que evoluem**

O aumento nos tamanhos corporais ocorreram desde que os animais apareceram pela primeira vez no registro de fósseis, cerca de 550 milhões de anos atrás, segundo o estudo.

### **23 / 02 / 2015 Astronautas preparam estação para táxis espaciais dos EUA**

Locais são ajustados para atracar voos da Boeing e da SpaceX. Primeiro teste para novo transporte não deve acontecer até o final de 2016.

### **23 / 02 / 2015 Chuvas irregulares no semiárido piauiense não animam agricultores**

Agricultores de Betânia, no interior do Piauí sofrem com chuvas irregulares. Em Paulistana o horizonte também não parece sinalizar boas notícias.

### **23 / 02 / 2015 Temperatura máxima vai a 34°C em domingo de sol após carnaval no Rio**

Cariocas e turistas lotaram as praias da cidade em dia ainda com blocos. Quase 1 milhão de turistas vieram ao Rio para o carnaval, segundo a Riotur.

### **23 / 02 / 2015 Arqueólogos alemães encontram duas estátuas da deusa Sekhmet no sul do Egito**

As duas estátuas, de rocha preta, foram descobertas pela equipe alemã de arqueólogos que estava realizando escavações no templo funerário do rei Amenófis III (1372-1410 a.C.), que está situado na margem ocidental do rio Nilo, em Luxor, 700 quilômetros ao sul do Cairo.

### **23 / 02 / 2015 Rio Tarauacá sobe e ultrapassa cota de transbordamento neste domingo**

Esta é a nona cheia que a cidade enfrenta, diz prefeitura. 'Se tornou um transtorno crônico', diz prefeito sobre enchentes na cidade.

### **23 / 02 / 2015 Em fevereiro, Pardo chegou a ter nível 10 vezes abaixo do ideal em Ribeirão/SP**

Medição mais crítica chegou a 0,29 metro de profundidade, aponta DAEE. Recarga de lençol usa volume; se chuva não continuar, seca pode voltar pior.

### **23 / 02 / 2015 Libéria reabre fronteiras após a queda do número de casos de ebola**

Medida havia sido tomada para conter o vírus. País afirma que houve queda nos contágios da doenças.

### **23 / 02 / 2015 8 espécies de peixes do interior de SP estão em ameaçadas de extinção em 2015**

Número de espécies em extinção aumentou 75% no Brasil em 10 anos. Junto com os invertebrados, os peixes lideram o ranking de extinção.

### **23 / 02 / 2015 Chuvas: Cuidados para combater dengue e chikungunya devem ser reforçados**

O principal sinal de alerta para as duas doenças é a febre, sobretudo quando desacompanhada de outros sintomas gripais, como dor de garganta e coriza.

### **23 / 02 / 2015 Game que ajuda no tratamento do Alzheimer é desenvolvido em Petrolina/PE**

Ferramenta estimula a memória, concentração e atenção dos pacientes. Jogo pode ser personalizado com dados e fotos de familiares.

### **23 / 02 / 2015 Plano de combater mosquitos com mosquitos transgênicos abre batalha na Flórida/EUA**

O FDA, que ainda está analisando a documentação da Oxitec, precisa aprovar a liberação dos insetos em campo. Mas a proposta provocou uma reação de ansiedade e protestos, que começou em 2011 e ganhou força com a aproximação da decisão da agência.

**23 / 02 / 2015 Nível de água do Sistema Cantareira volta a subir e atinge 10,4%**

Apesar de o nível estar crescendo desde o dia 5 de fevereiro, ainda é considerado crítico.

**24 / 02 / 2015 Despoluição da Baía de Guanabara chega a 49%, diz governador**

Secretário de Ambiente já havia alertado sobre meta de despoluição. "Tem que ficar o legado para a cidade", afirmou.

**24 / 02 / 2015 Acre: Brasileia decreta calamidade pública por causa das fortes chuvas**

Nível do rio chegou a 14,55 metros na manhã desta segunda-feira (23). Famílias estão sendo levadas para abrigos públicos.

**24 / 02 / 2015 Chernobyl: De zona proibida a paraíso da vida selvagem**

Local de maior desastre nuclear da história agora abriga diversas espécies animais e vegetais.

**24 / 02 / 2015 Projeto vai plantar 60 mil mudas de árvores em Imperatriz/MA**

As árvores frutíferas como a manga serão destinadas para as escolas. Técnicos fazem o cadastro das casas que querem receber as mudas.

**24 / 02 / 2015 Com risco de epidemia, Guará/SP intensifica combate à dengue**

Cidade confirmou 22 casos da doença em 2015; foram 2,7 mil em 2014. Prefeitura está investindo em ações de prevenção e combate ao mosquito.

**24 / 02 / 2015 Sistema Cantareira mantém elevação de nível d'água mesmo sem chuvas**

Segundo a Sabesp, se a elevação do nível dos seis reservatórios prosseguir, nos próximos dias, as retiradas de água serão feitas da primeira cota.

**24 / 02 / 2015 PF e Ibama prendem maior desmatador da Amazônia**

Ezequiel Antônio Castanha é acusado de dirigir uma quadrilha que se apoderava ilegalmente de terras de titularidade pública na Amazônia para depois desmatá-las e vendê-las como pasto a um preço elevado.

**24 / 02 / 2015 Tremor de magnitude moderada atinge a Espanha**

Terremoto foi sentido em várias províncias do país. Inicialmente não havia relatos de danos ou feridos.

**24 / 02 / 2015 IPCC se reúne, apesar da ausência de presidente acusado de assédio sexual**

Painel da ONU sobre Mudanças Climáticas está reunido no Quênia. Rajendra Pachauri teria enviado e-mails para pesquisadora de 29 anos.

**24 / 02 / 2015 Programa Produtor de Água começa a apresentar primeiros resultados**

Governo estimula política de pagamento por serviços ambientais voltada à proteção hídrica.

**24 / 02 / 2015 Cientistas da Espanha descobrem material alternativo à celulose**

Estudo detalha a produção deste novo tipo de polissacarídeo em bactérias. Descoberta pode ter importante aplicação na química, saúde e alimentação.

**24 / 02 / 2015 Aids: 1º caso teria sido em caçador de chimpanzés em 1908**

O caçador teria sido ferido e infectado enquanto monitorava o animal no sudeste do país e teria sido, portanto, a primeira pessoa conhecida por portar a doença.

**24 / 02 / 2015 Pesquisa da Ufes mostra como reduzir em 30% o consumo de água**

Hidrômetros individuais e descarga com caixa acoplada permitem economia. Estudo conclui que condição financeira de moradores interfere no consumo.

**24 / 02 / 2015 Aranha-marrom identifica pontos fracos de presa ao atacá-la**

Aracnídeo percebe regiões vulneráveis do corpo de animal para matá-lo e devorá-lo, aponta estudo feito na

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The crystal structure of kiddcreekite solved using micro X-ray  
diffraction and the EPCryst program  
Liu Wenyuan, Dong Cheng, Gu Xiangping, Liu Yu, Qiu Xiaoping, and Chen  
Yuchuan  
Mineral Mag, December 2014, v. 78, p. 1517-1525,  
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The crystal structure of camerolaite and structural variation in the  
cyanotrichite family of merotypes

S. J. Mills, A. G. Christy, C. Schnyder, G. Favreau, and J. R. Price  
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New arsenate minerals from the Arsenatnaya fumarole, Tolbachik volcano, Kamchatka, Russia. II. Ericlaxmanite and kozyrevskite, two natural modifications of Cu<sub>4</sub>O(AsO<sub>4</sub>)<sub>2</sub>  
I. V. Pekov, N. V. Zubkova, V. O. Yapaskurt, D. I. Belakovskiy, M. F. Vigasina, E. G. Sidorov, and D. Yu. Pushcharovsky  
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E. P. Lynch, A. Costanzo, M. Feely, N. J. F. Blamey, J. Pironon, and P. Lavin  
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doi:10.1180/minmag.2014.078.7.04

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Synthetic norsethite, BaMg(CO<sub>3</sub>)<sub>2</sub>: revised crystal structure, thermal behaviour and displacive phase transition  
H. Effenberger, T. Pippinger, E. Libowitzky, C. L. Lengauer, and R. Miletich  
Mineral Mag, December 2014, v. 78, p. 1589-1611,  
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Innsbruckite, Mn<sub>33</sub>(Si<sub>2</sub>O<sub>5</sub>)<sub>14</sub>(OH)<sub>38</sub> – a new mineral from the Tyrol, Austria  
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Anna Garavelli, Daniela Pinto, Donatella Mitolo, and Luca Bindi  
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Unique thallium mineralization in the fumaroles of the Tolbachik volcano,  
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- Working together for clear water (23 Feb 2015)

- <http://planetearth.nerc.ac.uk/tools/elink.aspx?m=150302&c=2&id=1775>

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#### Environmental Engineering Geoscience

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Neoformed magnetic minerals as an indicator of moderate burial: The key example of middle Paleozoic sedimentary rocks, West Virginia  
Myriam Kars, Charles Aubourg, and Isabel Suárez-Ruiz  
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Influence of mobile shale on thrust faults: Insights from discrete element simulations  
Sarah Dean, Julia Morgan, and J. P. Brandenburg  
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The dynamic behavior of shallow marine reservoirs: Insights from the Pliocene of offshore North Trinidad  
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## EARTH PAGES

### [A tsunami and NW European Mesolithic settlements](#)

Posted on [March 3, 2015](#) by [Steve Drury](#) | [Leave a comment](#)

About 8.2 ka ago sediments on the steep continental edge of the North and Norwegian Seas slid onto the abyssal plain of the North Atlantic. This huge mass displacement triggered a tsunami whose effects manifest themselves in sand inundations at the heads of inlets and fjords along the Norwegian and eastern Scottish coasts that reach up to 10 m above current sea level. At that time actual sea level was probably 10 m lower than at present as active melting of the last glacial ice sheets was still underway: the waves may have reached

20-30 m above the 8.2 ka sea level. So powerful were the tsunami waves in the constricted North Sea that they may have separated the British Isles from the European mainland by inundating [Doggerland](#), the low-lying riverine plain that joined them before global sea level rose above their elevation at around the same time. Fishing vessels plying the sandbanks of the southern North Sea often trawl-up well preserved remains of land mammals and even human tools: almost certainly Doggerland was prime hunting territory during the [Mesolithic](#), as well as an easily traversed link to the then British Peninsula. Mesolithic settlements close by tsunami deposits are known from Inverness in Scotland and Dysvikja north of Bergen in Norway and individual Mesolithic dwellings occur on the Northumberland coast. The tsunami must have had some effect on Mesolithic hunter gatherers who had migrated into a game-rich habitat. The question is: How devastating was it.



Reconstruction of Mesolithic hut based on evidence from two archaeological sites in Northumberland, UK. (credit: Lisa Jarvis; see <http://www.maelmin.org.uk/index.html> )

Hunter gatherers move seasonally with favoured game species, often returning to semi-permanent settlements for the least fruitful late-autumn to early spring season. The dominant prey animals, red deer and reindeer also tend to migrate to the hills in summer, partly to escape blood-feeding insects, returning to warmer, lower elevations for the winter. If that movement pattern dominated Mesolithic populations then the effects of the tsunami would have been most destructive in late-autumn to early spring. During warmer seasons, people may not even have noticed its effects although coastal habitations and boats may have been destroyed.



Stair-step moss (credit: Wikipedia)

Norwegian scientists Knut Rydgren and Stein Bondevik from Sogn og Fjordane University College, Sognda devised a clever means of working out the tsunami's timing from mosses preserved in the sand inundations that added to near-shore marine sediments. (Rydgren, K. & Bondevik, S. 2015. Most growth patterns and timing of human exposure to a Mesolithic tsunami in the North Atlantic. *Geology*, v. **43**, p. 111-114). Well-preserved stems of stair-step moss *Hylocomium splendens* still containing green chlorophyll occur, along with ripped up fragments of peat and soil, near the top of the tsunami deposit which has been uplifted by post-glacial isostatic uplift to form a bog. This moss grows shoots annually, the main growth spurt being at the end of the summer-early autumn growing season. Nineteen preserved samples preserved such new shoots that were as long as or longer than the preceding year's shoots. This suggests that they were torn up by the tsunami while still alive towards the end of the growing season, around late-October. All around the North Sea Mesolithic people could have been returning from warm season hunting trips to sea-shore winter camps, only to have their dwellings, boats and food stores devastated, if indeed they survived such a terrifying event.

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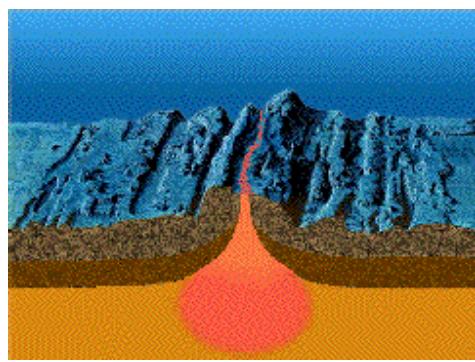
Tagged [Doggerland](#), [Mesolithic](#), [North Sea](#), [Storegga Slide](#), [Tsunami](#)

### [Glacial cycles and sea-floor spreading](#)

Posted on [February 17, 2015](#) by [Steve Drury](#) | [Leave a comment](#)

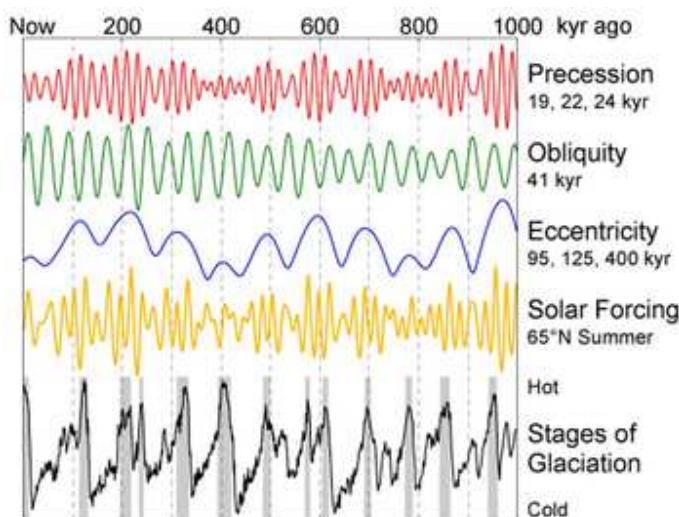
The *London Review of Books* recently published a lengthy review (Godfrey-Smith, P. 2015. The Ant and the Steam Engine. *London Review of Books*, v. **37**, 19 February 2015 issue, p. 18-20) of the latest contribution to Earth System Science by [James Lovelock](#), the man who almost singlehandedly created that popular paradigm through his Gaia concept of a self-regulating Earth (Lovelock, J. A *Rough Ride to the Future*. Allen Lane: London; ISBN 978 0 241 00476 0). Coincidentally, on 5 February 2015 *Science* published online a startling account of the inner-outer-inner synergism of Earth processes and climate (Crowley, J.W. et al. 2015. Glacial cycles drive variations in the production of oceanic crust. *Science* doi:10.1126/science.1261508). In fact serendipity struck twice: the following day a similar online article appeared in a leading geophysics journal (Tolstoy, M. 2015. Mid-ocean ridge eruptions as a climate valve. *Geophysical Research Letters*, doi:10.1002/2014GL063015)

Both articles centred on the most common topographic features on the ocean floor, abyssal hills. These linear features trend parallel to seafloor spreading centres and the magnetic stripes, which chart the progressive additions to oceanic lithosphere at constructive margins. Abyssal hills are most common around intermediate- and fast-spreading ridges and have been widely regarded as fault-tilt blocks resulting from extensional forces where cooling of the lithosphere causes it to sag towards the abyssal plains. However, some have suggested a possible link with variations in magma production beneath ridge axes as pressure due to seawater depth varied with rising and falling sea level through repeated glacial cycles. Mantle melting beneath ridges results from depressurization of rising asthenosphere: so-called 'adiabatic' melting. Pressure changes equivalent to sea-level fluctuations of around 100-130 m should theoretically have an effect on magma productivity, falls resulting in additional volumes of lava erupted on the ocean floor and thus bathymetric highs.



Formation of mid-ocean ridge topography, including abyssal hills that parallel the ridge axis. (credit: Wikipedia)

A test of this hypothesis would be to see how the elevation of the sea floor adjacent to spreading axes changes with the age of the underlying crust. John Crowley and colleagues from Oxford and Harvard Universities and the Korea Polar Research Institute analysed new bathymetry across the Australian-Antarctic Ridge, whereas Maya Tolstoy of Columbia University performed similar work across the Southern East Pacific Rise. In both studies frequency analysis of changes in bathymetry through time, as calibrated by local magnetic stripes, showed significant peaks at roughly 23, 41 and 100 ka in the first study and at 100 ka in the second. These correspond to the well known Milankovitch periods due to precession, changing axial tilt and orbital eccentricity: persuasive support for a glacial control over [mid-ocean ridge](#) magmatism.



Periodicities of astronomical forcing and global climate over the last million years (credit: Wikipedia)

An interesting corollary of the observations may be that pulses in sea-floor eruption rates emit additional carbon dioxide, which eventually percolates through the ocean to add to its atmospheric concentration, which would result in climatic warming. The maximum effect would correspond to glacial maxima when sea level reached its lowest, the reduction in pressure stimulating the greatest magmatism. One of the puzzling features of glacial cycles over the last million years, when the 100 ka eccentricity signal dominates, is the marked asymmetry of the sea-level record; slowly declining to a glacial maximum and then a rapid rise due to warming and melting as the Earth changed to interglacial conditions. Atmospheric CO<sub>2</sub> concentrations recorded by bubbles in polar ice cores show a close correlation with sea-level change indicated by oxygen isotope data from oceanic sediments. So it is possible that build-up of polar ice caps in a roundabout way eventually reverse cooling once they reach their greatest thickness and extents, by modulating ocean-ridge volcanism and thereby the greenhouse effect.

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#### **[January 2015 photo of the month](#)**

Posted on [February 3, 2015](#) by [Steve Drury](#) | [1 comment](#)



Angular unconformity at Telheiro Beach, Portugal (credit: Gabriela Bruno)

This image posted at [Earth Science Picture of the Day](#) would be hard to beat as the definitive [angular unconformity](#). It shows Upper Carboniferous marine metagreywackes folded during the [Variscan orogeny](#) overlain by Triassic [redbeds](#). Structurally it is uncannily

similar to [Hutton](#)'s famous unconformity at [Siccar Point](#) on the coast of SE Scotland, although the tight folding there is Caledonian in age and the unconformable redbeds are Devonian in age.

[1 Comment](#)

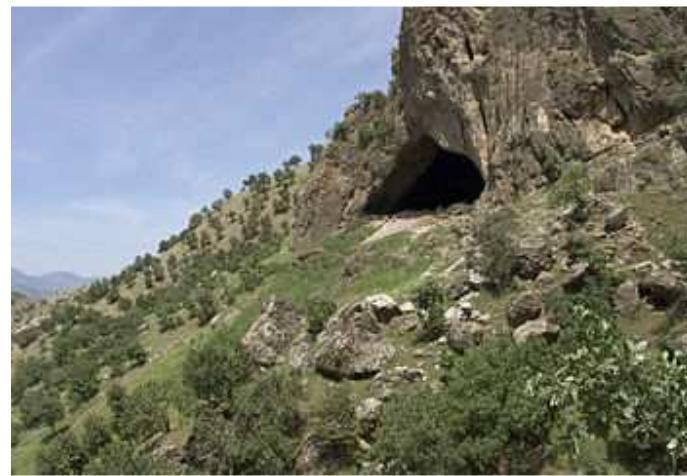
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### **[Human-Neanderthal cohabitation of the Levant](#)**

Posted on [February 3, 2015](#) by [Steve Drury](#) | [Leave a comment](#)

The earliest known remains of anatomically modern humans outside of Africa were found unearthed from the [Skhul](#) and Qafzeh caves in what is now northern Israel. Their context was that of deliberate burial at a time when climate was cooling from the last interglacial, between 90 to 120 ka. The Levant was also the repository for a number of well-preserved Neanderthal skeletons, most dating to between 35-65 ka, including ten individuals at [Shanidar](#) in today's northern Iraq, some of whom were also deliberately buried including one whose grave reputedly contained evidence for a floral tribute. The 25 ka gap between the two populations has previously been regarded as evidence for lack of contact between them. However, the [Tabun Cave](#) in modern Israel has yielded tools attributed to Neanderthal [Mousterian culture](#) that may indicate their intermittent presence from 200 to 45 ka, and fossils of two individuals dated at ~122 and ~90 ka. The remains at Skhul and Qafzeh are significantly more rugged or robust than African contemporaries and have been considered possible candidates for Neanderthal-modern human hybrids. But whatever their parentage, it seems they became extinct as the climate of the Levant dried to desert conditions around 80 ka.



Entrance to the Shanidar Cave, northern Iraq, occupied by Neanderthals between 35-65 ka (credit: Wikipedia)

A more promising overlap between modern human and Neanderthal occupation comes with the discovery by a group of Israeli, US, Canadian, German and Austrian scientists of a much younger [anatomically modern human](#) cranium from the Manot Cave, also in northern Israel (Herschkovitz, I. and 23 others 2015. Levantine cranium from Manot Cave (Israel) foreshadows the first European modern humans. *Nature* (online) doi:10.1038/nature14134). The cranium has a U-Th radiometric age of ~55 ka, well within the time span of Neanderthal occupation. Moreover, Manot Cave is one of a cluster of occupied sites in northern Israel, with separations of only a few tens of kilometres: undoubtedly, this individual and companions more than likely met Neanderthals. The big question, of course, is did the neighbours interbreed? If so the Levant would be the confirmed as the probable source of hybridisation to which the DNA of non-African living humans points. There may be an insuperable difficulty in taking this further: it is thought that the high temperatures of the region, despite its dryness, may have destroyed any chance of reconstructing ancient genomes. Yet one of the first Neanderthal bones to yield useful genetic material was from Croatia, which is not a great deal cooler in summer.

#### *Related articles*



[Humans and Neanderthals: A Mediterranean Romance?](#)



[Skull shows earliest Humans and Neanderthals cross-breed](#)



~55 thousand year old modern human from Manot cave in Israel

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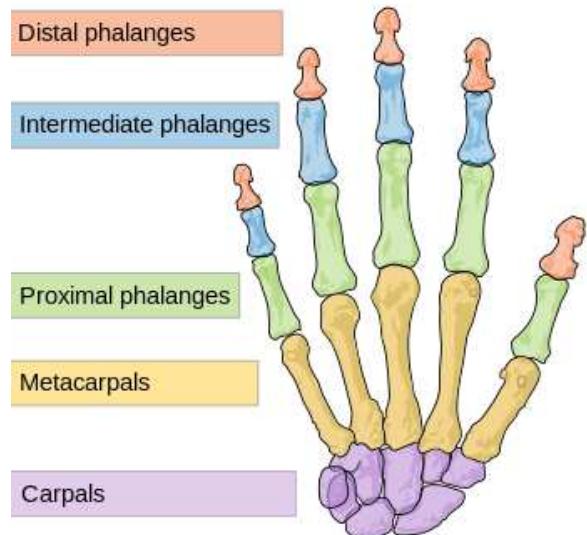
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### **[Convincing, indirect evidence for early toolmakers](#)**

Posted on [February 2, 2015](#) by [Steve Drury](#) | [Leave a comment](#)

A surprising number of animals pick up items from their surroundings and use them, mainly to get at otherwise inaccessible foodstuffs. What sets humans apart from such tool users is that we make them and for a long time part of our repertoire has been tools used to make other tools; so-called 'machine tools'. An example is a piece of antler used to pressure-flake flint to give a stone blade a better edge, a more recent one is the increasing use of robots on assembly lines. Making a tool is impossible for a bird with only its beak and ill-adapted feet, while even a chimpanzee lacks various forms of grip needed for precisely directed force and manipulation. It was Frederick Engels who first focussed on the importance of the hand being freed to evolve the capacity for manual labour by the permanent adoption of an upright posture and gait, in his essay *The Part Played by Labour in the Transition from Ape to Man* written in 1876.

The earliest tools known turned up in 2.6 Ma old sediments at Gona in NE Ethiopia, while evidence for tool use is well accepted from cracked and sliced bones found in sediments dated at 2.5 Ma from Bouri in the same region. In neither case can the finds be tied to fossil remains of the makers and users, the earliest direct link emerging from famous [Olduvai Gorge](#) in western Tanzania, where crude Oldowan tools and worked bones occur with incomplete remains of a hominin, dubbed [Homo habilis](#) ('handy man') because of this association. Somewhat more controversial are bones that show cuts and scrape marks plus signs of having been cracked open that were found in a 3.4 Ma context at [Dikika](#), also in Ethiopia, within the same sedimentary horizon as the young [Australopithecus afarensis](#) known as Selam ('Hello'). The [Dikika](#) material is little different from 0.9 to 1.2 Ma younger bones at Bouri and Olduvai: the controversy seems to stem more from its much greater age and association with hominins deemed by some to have been incapable of creating tools.



Bone structure of the (right) human hand. (credit: Wikipedia)

An entirely novel approach to the issue of the first tools and their makers, which with little doubt would have tickled Engels no end, is a careful anatomical and physiological examination of fossil hominin hand bones in comparison with those of chimps and living humans (Skinner, M.M. et al. Human-like hand use in [Australopithecus africanus](#). *Science*, v. **347**, p. 395-399). The bones being scrutinized are the five metacarpals that form the links in the palms from muscles of the forearm to finger and thumb movements and thus to various kinds of grip. In humans there are a host of ways of gripping objects from the precision of opposed thumb and finger pinching, especially that using the forefinger, to the squeezing power grip that wraps thumb and all fingers around an object and makes a fist. The best a chimp can do is grabbing a branch, to which its knuckle-walking hands are well adapted. The tips of the metacarpals are mechanically loaded according to the types of grip used repeatedly in life and that works to modify the physical density of the tips' spongy bone tissue in patterns that vary according to habitual usage of the hand and its digits. This new approach is reputedly far more diagnostic than the actual shape of metacarpal bones, and requires high-resolution CT scanning.

Known early human and Neanderthal tool-makers show very similar patterns: in fact they suggest far more heavy loading through various kinds of grip than the metacarpals of humans from the modern period. In 1.8 to 3.0 Ma old *A. africanus* and *Paranthropus*

*robustus* (a gorilla-like but bipedal australopithecine) from South Africa metacarpals suggest that both were habitually using a tree-climbing grip, much as chimpanzees do, but more closely resembled modern human and Neanderthal committed tool users. Both were certainly capable of using forceful precision grips to make and use tools up to 0.5 Ma earlier than the date of the earliest known tools. So far the technique has not been applied to the palm bones of earlier hominins such as *A. afarensis* (2.9-3.9 Ma) and *Orrorin tugenensis* (~6 Ma). Despite the suggestion of tool-making capability, agreeing that it did take place in non-*Homo* hominins must await finds of tools, as well as signs of their use, in close association with fossil remains of their makers. The Dikika association is simply not enough. Yet, some bipedal being must have made tools before the date of the earliest ones (~2.6 Ma) discovered at Gona. Look at it this way: it is a lucky archaeologist who discovers every piece of evidence for a fundamental social change at one site. The fact that, by definition, the vast bulk of Pliocene and Pleistocene sediments that may contain the key evidence is either buried by younger material or was a victim of erosion, means that the chance of resolving the origin of the fundamental feature of human behaviour is tiny. The chance that scientists will continue looking is astronomically higher.

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#### [Reconstructing the structure of ancient vegetation canopies](#)

Posted on [January 25, 2015](#) by [Steve Drury](#) | [Leave a comment](#)

One of the central measures used to describe modern ecosystems is the ratio of foliage area to that of the ground surface – the [leaf area index](#) (LAI) – which expresses the openness of vegetation canopies. A high LAI helps to retain moisture in the soil, partly by shading and cooling the surface to reduce evaporation and partly by stopping surface soil from being battered to a concrete-like consistency by heavy rain, which reduces the amount of water that can infiltrate. It is possible to estimate LAI across today's entire land area using satellite image data but a proxy for palaeoecological LAI has remained hard to find.



Hemispherical photograph used to calculate modern canopy cover. (credit: Wikipedia; photo by S.B. Weiss)

The outer coating of leaves in well-shaded (high LAI) areas tends to have protective or pavement cells that are larger and have more complicated shapes than does that of leaves in more open canopies. The framework of leaf cells is silica-based and made up of structures known as phytoliths whose morphologies vary in much the same way as the cells that they support. So theoretically it is possible to use fossil phytoliths in terrestrial sediments to estimate LAI variations through time in local canopies, but first the approach needs a means of calibration from living ecosystems. The vegetation of Central American Costa Rica varies through the entire range of possible LAI values, which leads to varying amounts of sunlight available to the leaves of cover plants. Measuring the area and the degree of shape-complexity of phytoliths in modern soils there shows that each is positively correlated with LAI.



A modern herbivorous mammal (lowland paca) from dense forest in Costa Rica. (Photo credit: Wikipedia)

Putting this approach to use in the Cenozoic terrestrial sediments of Patagonia, US and Argentinean palaeoecologists aimed to examine how the evolution of the teeth of herbivorous mammals – a major feature in their speciation – linked to changes in vegetation structure (Dunn, R.E. et al. 2015. Linked canopy, climate and faunal change in the Cenozoic of Patagonia. *Science*, v. **347**, p. 258-261). Using phytoliths they were able to show that in the Eocene the area was covered by dense, closed forest canopies that gradually became more open towards the end of the Eocene to be replaced by open forest and shrubland habitats in the Oligocene and Miocene, with a brief period of regreening. It was during the period of more open vegetation that tooth structure underwent the most change. Chances are that the vegetation shifts began in response to the onset of Antarctic glaciation at the beginning of the Oligocene Epoch and related climate change at the northern margin of the Southern Ocean. Changes in the herbivore teeth may have been in response to the increasing amount of dust adhering to leaves as canopies became more open and soil increasingly dried out.

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#### **[Bicentenary of the first national geological map](#)**

Posted on [January 25, 2015](#) by [Steve Drury](#) | [2 comments](#)

It's good to know that the geosciences have had revolutionising developments to match those of the rest of science. Forget the Battle of Waterloo in 1815, which of course was '*the nearest-run thing you ever saw in your life*' when the Brits were saved from defeat by the timely arrival of the Prussians: This year we can celebrate one that literally put geology on the map, kicked-off the systematic exploration for every kind of physical resource, thereby putting a great deal of money in the pockets of coal, petroleum and metal moguls and making geology a career rather than a pastime. In 1815 [William Smith](#) published *A Delineation of the Strata of England and Wales with part of Scotland*, which despite the title was a map showing the basic geology and structure of the whole of England and Wales: the first ever map showing accurately the distribution of rocks for an entire country. The original, at 2.6 by 1.8 m, dominates the main staircase at Burlington House, the home of the [Geological Society of London](#).



William Smith's A Delineation of the Strata of England and Wales with part of Scotland (1815)

Tom Sharpe has nicely summarized the key facts surrounding Smith's masterpiece (Sharpe, T. 2015. The birth of the geological map. *Science*, v. 347, p. 230-232). One feature that I certainly did not know was that the colour scheme for the different stratigraphic units was based on the dominant colour of the rocks themselves, such as purples for the abundant slates of the [Lower Palaeozoic](#), brown and red for the Old- and [New Red Sandstone](#), greys and blacks for the Coal Measures and green for the Greensand, which until quite recently remained widely used to signify Cambrian, Ordovician and Silurian; Devonian and Permian; Upper Carboniferous and Cretaceous.

Although celebrated today, Smith's map was panned by the gentlemen geologists of the Geol Soc, who attempted to do a better job, but failed ignominiously. William Smith was not a leisured chap of the Enlightenment, but worked for a living surveying coal mines, navigating canals and draining fens. Despite their antipathy, the Fellows of the Geological Society of London knew a good earner when they saw one and plagiarized Smith's work and undercut his regular price for his map. As a result he ended up in a London debtors' prison. Even on the day of his release in 1819, bailiffs seized his house and its contents. The Geol Soc eventually did honour Smith with its Wollaston Medal in 1831, its then president [Adam Sedgwick](#) dubbing him 'the Father of English Geology': by that time geology had become a profession...

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## [\*\*Verneshots \(huge volcanic gas blasts\) ten years on\*\*](#)

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One of the most daring hypotheses of modern geosciences: is that of the '[Verneshot](#)' reported by Earth Pages in 2004. Jason Phipps Morgan and colleagues explored the possible consequences of a build-up of volatiles in plume-related magmas at the base of thick continental lithosphere beneath cratons, prior to the eruption of continental flood basalts. They suggested that pressure would eventually result in an explosive release at a lithospheric weak point, followed by collapse above the plume head that would propagate upwards, at hypersonic speeds. Modelling the forces involved, the authors of the novel idea considered that they would be sufficient to fling huge rock masses into orbit. Verneshots might neatly explain the circumstances around mass extinctions, such as their coincidence with [continental flood basalt](#) events; large impact structures, most likely at the antipode of the event; global debris layers containing shocked rock, melt spherules; unusual element suites and compounds (including fullerenes); and enough toxic gas to cause biological devastation.

Ten years on, Verneshots are back, again in the prestigious journal *Earth and Planetary Science Letters*, and this time among the co-authors are Morgan *père et fils* (W. Jason a founder of plate tectonics, and Jason P. who launched the idea). This time the yet-to-be – accepted hypothesis comes with evidence of an extremely unusual and fortuitous kind (Vannucchi, P. et al. 2015. Direct evidence of ancient shock metamorphism at the site of the 1908 [Tunguska event](#). *Earth and Planetary Science Letters*, v. 409, p. 168-174). The origin of the paper lies in an attempt to verify reports of shocked quartz in samples collected close to the centre of the 2000 km<sup>2</sup> devastation that resulted from what is now accepted to have been a comet or asteroid air-burst explosion in June 1908 in the Tunguska region of Siberia. Apart from a disputed 300 m crater in the area, the Tunguska Event left no long-lived sign: it 'merely' knocked over millions of trees. However, its epicenter lay in a 10 km depression ringed by hills, that has been suggested to be a volcanic centre associated with the end-Permian [Siberian Traps](#).



Trees knocked down and burned over hundreds of square km by the 1908 Tunguska Event (credit: Leonid Alekseyevich Kulik deceased)

The reported shocked quartz locality turned out to be associated with an isolated occurrence of quartz-rich sand and rounded clasts of quartzite that contains sedimentary structures. The occurrence is surrounded by basalts of the Siberian Traps, yet is situated topographically above them. The quartzite is thought to be Permian terrestrial sandstone that commonly underlies much of the remaining extent of Siberian Traps.

Quartzite clasts do indeed contain shocked quartz, together with pseudotachylite glass veinlets, quartz and feldspar crystal growth on sedimentary grains and silica-rich glassy spherules. These features are not uniquely diagnostic of shock metamorphism, but are oddly absent from the surrounding Siberian Traps nearby, which suggests that whatever formed them predated the final eruptive stages of the end-Permian large igneous province. Indeed it would be unlikely that airburst of some extraterrestrial bolide in 1908 could produce the metamorphic features of the quartzites without setting ablaze the trees that it felled. A second possibility, that the Tunguska Depression is a Permo-Triassic impact crater and the quartzites being part of an associated central uplift runs into the unlikely coincidence of lying less than 5 km from the 1908 epicentre.

A third hypothesis is that the Tunguska Depression is a massive diatreme associated with a [Verneshot](#). Another odd association lies 8 km to the south of the epicentre, a carbonatite that is one of many, along with smaller pipe-like structures all possibly linked to magmatic gas escape. The Tunguska Event, a mighty puzzle in its own right, may perhaps be eclipsed. Will silence return as it did after the original Verneshot hypothesis was published? Quite possibly, but another quirk about the Siberian Traps was reported by Earth Pages in mid-2014. In a contribution to a link between this massive end-Permian volcanic effusion and the [Permian-Triassic mass extinction](#) it was noted that in the Chinese sedimentary repository of evidence for the extinction there is an [isolated spike in the abundance of nickel](#) that is almost certainly of volcanic origin, but only the one when repeated flood basalt events perhaps ought to have led to a series of nickel anomalies. One huge volcanic gas release as the Siberian Traps were building up?

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### **[Bibliometrics: the numbers game](#)**

Posted on [January 15, 2015](#) by [Steve Drury](#) | [1 comment](#)

In mid-December, [British universities](#), their constituent units and departments, and most academics experienced the same kind of traumatic day familiar to 18-year olds awaiting the examination results on which their advancement to higher education, or not, depended. December 18<sup>th</sup>, 2014, was REF-Day. Since its predecessor (RAE-Day), 8 years before, a vast – by university standards – effort went into preparing bids on a department-by-department basis to rank them nationally and conflate individual assessments to build a sort of institutional league table for research excellence; hence REF stands for [Research Excellence Framework](#) (the RAE was the less meritorious-sounding [Research Assessment Exercise](#)). It resembled the [Guide Michelin](#) or [Automobile Association star system](#) for restaurants and hotels or guest houses. The reason for the 8-year frenzy of activity was that the outcomes aimed to inform the selective allocation of governmental research funding. Unsurprisingly, this kind of competition stemmed from the Tory government of Margaret Thatcher, which in 1986 set the scene for ‘performance-related’ funding rather than that based on peer review of each individual bid for major grants, which preceded it.

To itemise each aspect of the way the REF worked could take the majority of Earth Pages readers to an early and ignoble grave. It centred on departmental selection from its full-time researchers of those who were deemed to be ‘research active’ and those who were

not, the former having to select four recently published works or 'outputs'. They had to self-assess each according to its 'impact', defined as '*an effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia*'. Institutions vetted and bundled individual submissions, collated them in the subject areas designated by the REF, then sent them off to 'REF Central', where they were to be reviewed by subject-specialist panels that gave out the stars for each submitted item of work: \*\*\*\* = world-leading (30% were deemed to be); \*\*\* = internationally excellent (46%); \*\* = recognized internationally (20%); \* = recognized nationally (3%); unclassified = below the standard of national recognition (1% – presumably those obviously lacking star quality were weeded out at institution level). There were more than 190 thousand 'outputs', which begs the questions; Were all of them read by at least one specialist panel member? Against what standards were they judged?

On average, each of the roughly 1000 panelists would have had to consider about 190 outputs in greater depth than a casual skim, or more if some were read by several panelists. Outputs were rated '*in terms of their "originality, significance and rigour", with reference to international research quality standards', 'the "reach and significance" of impacts on the economy, society and/or culture' and the part they played in their department's contribution to '*the vitality and sustainability... of the wider discipline or research base*'. On paper – and believe me, REF Central produced plenty of wordy PDFs of guidance – this level of scrutiny makes the adjective 'daunting' seem a bit of an understatement. Entering into this spirit of things in the gleeful manner of a Michelin or AA assessor does seem to me a bit hard to grasp. I wonder if the panels in reality just checked each submission for signs of an overly hubristic vision of self-worth.*

To some extent, the issue of each output's citation count or other bibliometric measure must at some stage have come into REF reckoning, and here is what spurred me to defy normal cautions about boredom as a contributor to general organ failure. Physicist Reinhard Werner of Leibniz University in Hanover, Germany believes that deciding on funding and hiring, or firing, needs to steer well-clear of [impact factors](#), citations and other kinds of bibliometrics (Werner, R. 2015 The focus on bibliometrics makes papers less useful. *Nature*, v. **517**, p. 245). Scientists cite other works for many reasons, some worthy and some less so. But it is rare that in doing so we express any opinion on the overall significance of the work that we choose to cite. Yet, conversely, a researcher can choose a field, phrase some findings and submit to such and such journal that will boost their citation frequency and impact. Just by writing about some mundane topic in a publicly accessible way, reviewing the work of lots of other people, or simply writing about this or that topic as observed or measured in an especially highly populous country where science is really booming does much the same thing. Werner makes a telling point, 'When we believe that we will be judged by silly criteria, we will adapt and behave in silly ways'. Although he does not touch on the absurdities of the REF – why on Earth would he? – Werner comments on distortion of the job market, and peer-reviewed journals. He also pleads for a return to proper scrutiny of scientific merit and, I suspect, for cutting hubris off at the roots.

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#### [\*\*Judging earthquake risk\*\*](#)

Posted on [December 30, 2014](#) by [Steve Drury](#) | [3 comments](#)

The early 21<sup>st</sup> century seems to have been plagued by very powerful earthquakes: 217 greater than Magnitude 7.0; 19 > Magnitude 8.0 and 2 > Magnitude 9.0. Although some lesser seismic events kill, those above M 7.0 have a far greater potential for fatal consequences. Over 700 thousand people have died from their effects: ~20 000 in the [2001 Gujarat earthquake](#) (M 7.7); ~29 000 in [2003 Bam earthquake](#) (M 6.6); ~250 000 in the 2004 Indian Ocean tsunami that stemmed from a M 9.1 earthquake off western Sumatra; ~95 000 in the [2005 Kashmir earthquake](#) (M7.6); ~87 000 in the [2008 Sichuan earthquake](#) (M 7.9); up to 316 000 in the [2010 Haiti earthquake](#) (M 7.0); ~20 000 in the 2011 tsunami that hit NE Japan from the M 9.0 Tohoku earthquake. The 26 December 2004 Indian Ocean tsunamis spelled out the far-reaching risk to populated coastal areas that face oceans prone to seismicity or large coastal landslips, but also the need for warning systems: tsunamis travel far more slowly than seismic waves and, except for directly adjacent areas, there is good chance of escape given a timely alert. Yet, historically [http://earthquake.usgs.gov/earthquakes/world/most\\_destructive.php](http://earthquake.usgs.gov/earthquakes/world/most_destructive.php), deadly risk is most often posed by earthquakes that occur beneath densely populated continental crust. Note that the most publicised earthquake that hit San Francisco in 1906 (at M 7.8) that lies on the world's best-known fault, the San Andreas, caused between 700 and 3000 fatalities, a sizable proportion of which resulted from the subsequent fire. For continental earthquakes the biggest factor in

deadly risk, outside of population density, is that of building standards.



A poor neighbourhood in Port au Prince, Haiti following the 2010 earthquake measuring >7 on the Richter scale. (credit: Wikipedia)

It barely needs stating that earthquakes are due to movement on faults, and these can leave distinct signs at or near to the surface, such as scarps, offsets of linear features such as roads, and broad rises or falls in the land surface. However, if they are due to faulting that does not break the surface – so-called ‘blind’ faults – very little record is left for geologists to analyse. But if it is possible to see actual breaks and shifts exposed by shallow excavations through geologically young materials, as in road cuts or trenches, then it is possible to work out an actual history of movements and their dimensions. It has also become increasingly possible to date the movements precisely using radiometric or luminescence means: a key element in establishing seismic risk is the historic frequency of events on active faults. Some of the most dangerous active faults are those at mountain fronts, such as the Himalaya and the American cordilleras, which often take the form of surface-breaking thrusts that are relatively easy to analyse, although little work has been done to date. A notable study is on the West Andean Thrust that breaks cover east of Chile’s capital Santiago with a population of around 6 million (Vargas, G. *et al.* 2014. Probing large intraplate earthquakes at the west flank of the Andes. *Geology*, v. **42**, p. 1083-1086). This fault forms a prominent series of scarps in Santiago’s eastern suburbs, but for most of its length along the Andean Front it is ‘blind’. The last highly destructive on-shore earthquake in western South America was due to thrust movement that devastated the western Argentinean city of Mendoza in 1861. But the potential for large intraplate earthquakes is high along the entire west flank of the Andes.

Vargas and colleagues from France and the US excavated a 5 m deep trench through alluvium and colluvium over a distance of 25 m across one of the scarps associated with the San Ramon Thrust. They found excellent evidence of metre-sized displacement of some prominent units within the young sediments, sufficient to detect the effects of two distinct, major earthquakes, each producing horizontal shifts of up to 5 m. Individual sediment strata were dateable using radiocarbon and optically stimulated luminescence techniques. The earlier displacement occurred at around 17-19 ka and the second at about 8 ka. Various methods of estimation of the likely earthquake magnitudes of the displacements yielded values of about M 7.2 to 7.5 for both. That is quite sufficient for devastation of now nearby Santiago and, worryingly, another movement may be likely in the foreseeable future.

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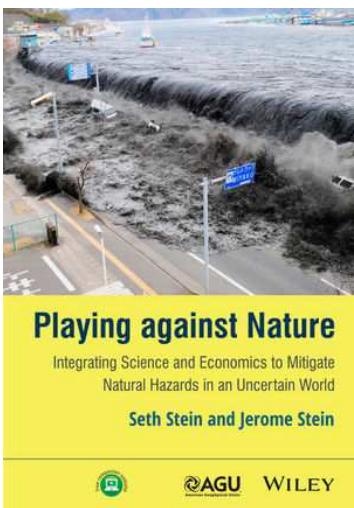
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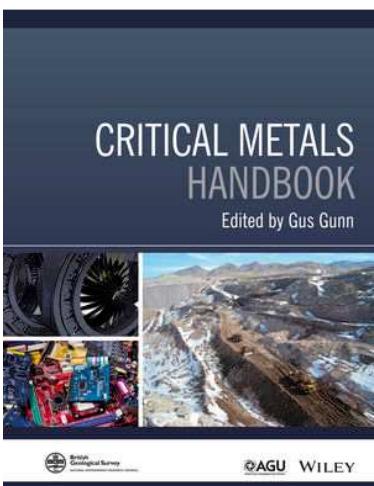
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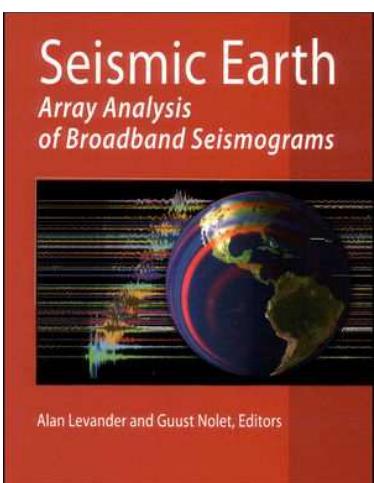
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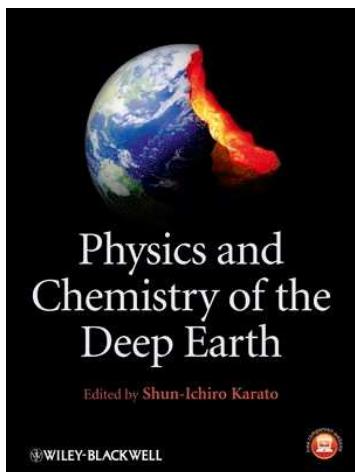
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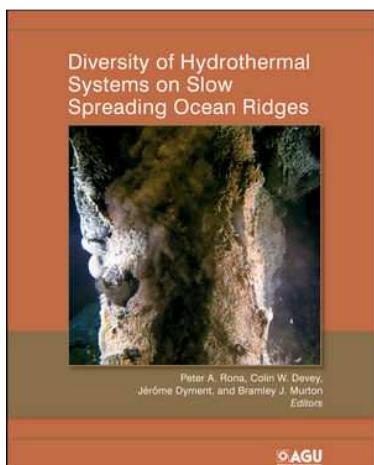
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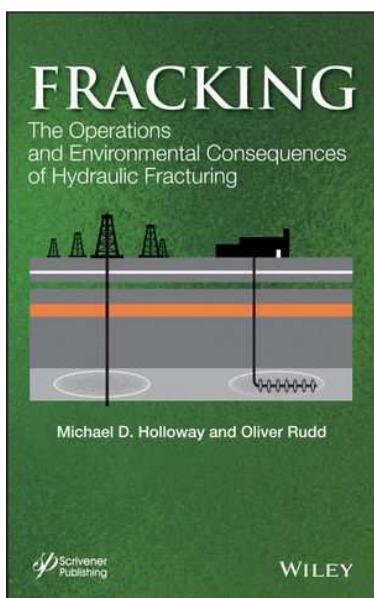
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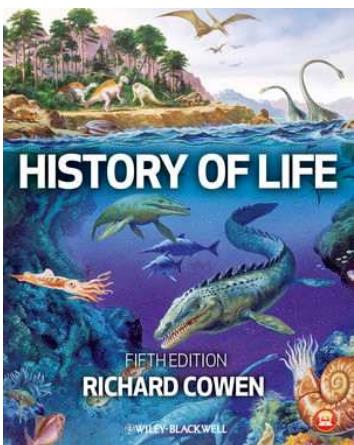
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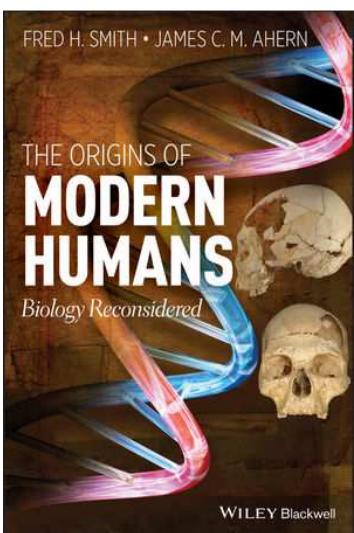
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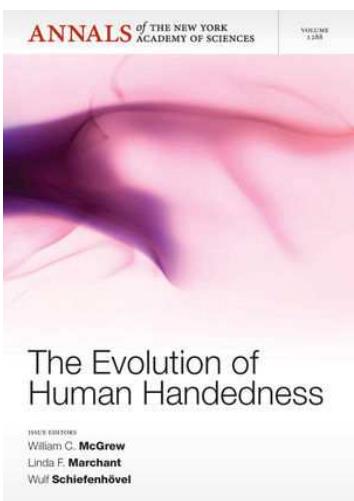
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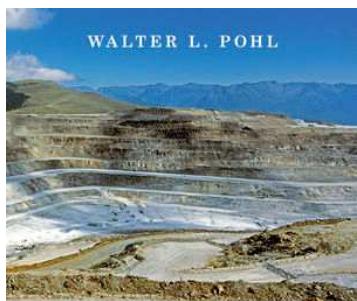
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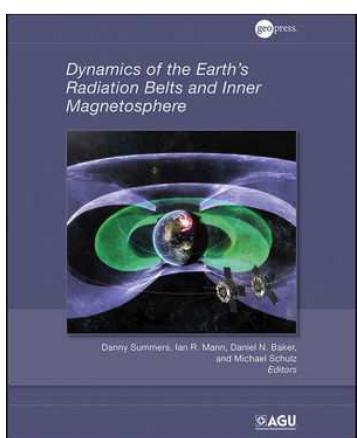
- **Economic Geology: Principles and Practice**



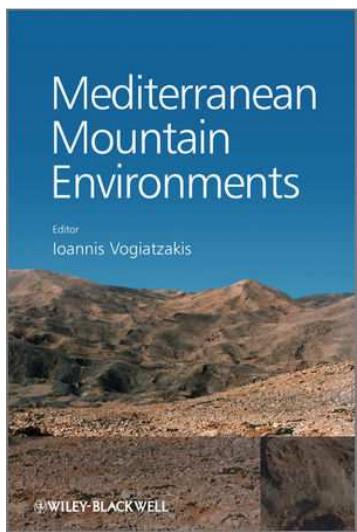
## Economic Geology Principles and Practice

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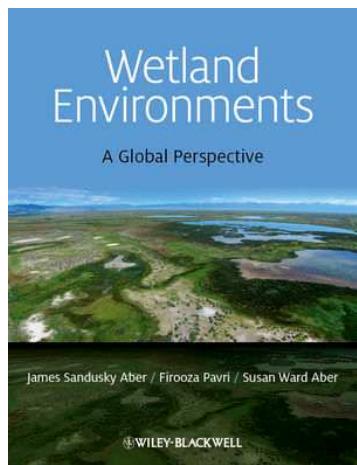
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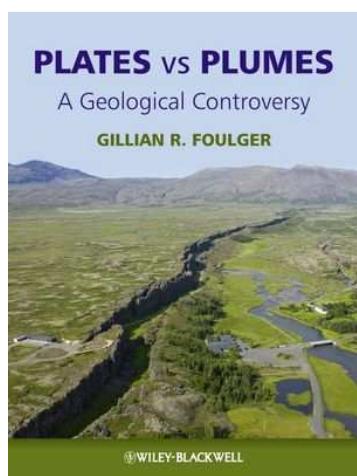
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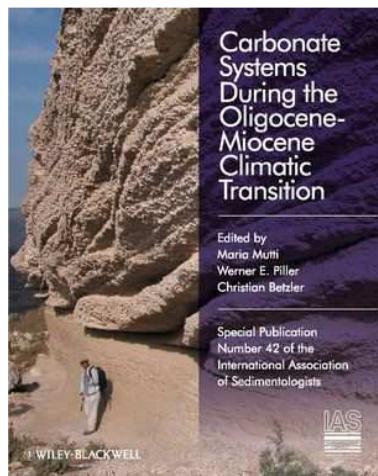
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- **Plates vs Plumes: A Geological Controversy**



- **Carbonate Systems During the Oligocene-Miocene Climatic Transition: (Special Publication 42 of the IAS)**



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