

# GEOBRASIL

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### AMBIENTE BRASIL

### SCIENCE

### IAPC

### EARTH PAGES

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### AMBIENTE BRASIL

### **Calor e pouco chuva vão marcar trimestre na Amazônia**

Alerta foi dado pelo Sistema de Proteção da Amazônia. Rondônia, Mato Grosso e Tocantins devem registrar poucas chuvas.

### **Comissão baleeira proíbe esquimós de caçar cetáceos**

Caça de baleias na Groenlândia passa a ser proibida após o término da cota no final de 2012.

### **EUA registram redução histórica em emissão de CO2, diz estudo**

No entanto, em escala mundial, a concentração deste gás de efeito estufa alcançou cifras históricas.

### **Cientistas são criticados por uso de Comic Sans em anúncio de partícula**

Pesquisadores anunciaram observação de partícula subatômica inédita. No Twitter, críticos da Comic Sans expressaram suas opiniões.

### **Pentágono se inspira na lagosta 'com soco mais rápido do mundo'**

Estrutura das patas da lagosta-boxeadora está sendo estudada para a construção de aeronaves militares mais resistentes.

### **Coreia do Sul anuncia em reunião que caçará baleias para fim científico**

País aproveitará brecha em moratória da pesca, mas sem apresentar plano. Plano foi divulgado em encontro da Comissão Baleeira Internacional.

### **Ministério Público do Pará denuncia desmatamento em assentamentos**

Ação impede criação de assentamentos sem licença em seis estados. Segundo MP, locais concentram focos de desmatamento na região.

### **China concentrará crescimento mundial de energia renovável**

Relatório da Agência Internacional de Energia diz que 40% do aumento da eletricidade vinda de fontes renováveis até 2017 será na China.

### **Ibama bloqueia exportações de peixes ornamentais no Pará**

Empresas estariam com licenças ambientais irregulares. Autorizações para exportação e embarques já foram canceladas.

### **Justiça de MT obriga Funai a mostrar plano de devolução de terra indígena**

Fundação terá prazo de 10 dias para apresentar projeto para desocupação. Petroleira italiana prometeu sair da área na Eco 92, mas não cumpriu.

### **Melão com gosto de limão é cultivado na Espanha e chega ao Reino Unido**

Fruta híbrida deve estar disponível nos supermercados em três semanas. Espécie torna o gosto do melão mais acentuado; unidade custará R\$ 5.

### **Municípios amazonenses recebem R\$ 3,9 milhões para recuperação de municípios atingidos por enchente**

Sete municípios do Amazonas atingidos por enchentes e erosão fluvial entre fevereiro e abril deste ano receberão os recursos para ações de socorro, assistência às vítimas e restabelecimento de serviços.

### **Japão: investigação conclui que acidente em Fukushima também foi causado pelo homem**

"Apesar de terem tido uma série de oportunidades para adotar medidas, as agências reguladoras e a Tepco adiaram decisões deliberadamente, não agiram ou tomaram decisões que eram convenientes para si próprias."

### **Índios saíram de área de Belo Monte se empresa cumprir contrapartidas**

Carta cobra ações da Norte Energia para indígenas afetados por usina. Desde 21 de junho, 350 manifestantes ocupam sítio Pimental, no Pará.

### **Estrela semelhante ao Sol perde brilho em apenas 2 anos, diz estudo**

Pesquisa publicada na 'Nature' aponta acontecimento dramático 'misterioso'. Estrela está localizada a 456 anos-luz da Terra.

### **Espécie rara de sapo é batizada em homenagem ao príncipe Charles**

'Hyloscirtus princecharlesi' é natural do Equador e está ameaçada. Reconhecimento foi feito por esforços do príncipe para proteger florestas.

### **Descoberta nova espécie de pterossauro que habitava a Europa**

Presença de animal no continente europeu reforça a ideia de que pterossauros, do grupo tapejarídeo, teriam contribuído com a

disseminação das angiospermas no mundo.

### **Clima mais quente já afeta tamanho de plantas na Austrália, diz estudo**

Mudança de temperatura no país reduziu largura de folha em 2 mm. Segundo cientistas, vegetais se adaptam à nova realidade do planeta.

### **Gripe A já faz 72 mortes nos estados da Região Sul em 2012**

O número de mortes ocorridas este ano na região já supera o dobro das ocorrências nos dois anos anteriores somadas. Os três estados registraram 21 óbitos em 2010 e 14 em 2011.

### **Mais de 1 milhão estão há 5 dias sem energia nos EUA**

Milhares de técnicos ficaram sem folga no feriado do Dia da Independência, pois foram mobilizados para tentar consertar as redes elétricas.

### **Rio+20 evidenciou protagonismo da sociedade civil, avaliam deputados**

Em balanço feito pela Comissão Mista Permanente de Mudanças Climáticas nesta quarta-feira (4), os deputados afirmaram que a reunião falhou em não estabelecer metas nem definir um fundo que financiasse as ações pelo desenvolvimento sustentável, mas permitiu que a discussão sobre um mundo sustentável e a economia verde se popularizasse.

### **Ibama e indústria apoiam substituição de fonte de energia em padarias**

Existem no mercado opções até mais eficientes dos que os fornos a lenha. O problema é que, no caso das padarias, principalmente do interior, as empresas não conseguem arcar com o custo da substituição.

### **Após o Veta Dilma, nova campanha mobiliza a sociedade civil, contra o texto final do Código Florestal**

Organizada pelo Comitê Brasil em Defesa das Florestas e do Desenvolvimento Sustentável, o novo mote da campanha é #OjogoNãoAcabou, e por meio de um site será possível conhecer o autor das piores emendas que integram as 689, propostas para modificar o texto final da legislação.

### **Mulher é flagrada com presas de marfim no aeroporto de Los Angeles/EUA**

Algumas delas eram esculpidas em forma de estátua. Ela também levava bolsas de couro de elefante, crocodilo e arraia.

### **Cientistas descobrem partícula subatômica inédita**

Experiências apontam que essa pode ser a chamada 'partícula de Deus'. Novas pesquisas são necessárias para afirmar que este é o bóson de Higgs.

### **Stephen Hawking perde aposta por possível achado da 'partícula de Deus'**

Físico britânico pagará US\$ 100 a colega americano se confirmada a suspeita de que o Bóson de Higgs foi encontrado.

### **Manifestantes vestidos de panda dançam por preservação em Londres**

Ao menos cem pessoas desfilaram pela Trafalgar Square nesta quarta-feira (4). Segundo organização, urso panda é considerado ameaçado de extinção.

### **Bombeiros resgatam pinguins no RJ**

Desde a última sexta-feira, 47 pinguins da espécie "Magalhães" já foram resgatados, a maioria nas praias do Recreio dos Bandeirantes.

### **Documento alerta o uso de mercúrio nos garimpos do AM**

Na tentativa de regularizar os garimpos do Amazonas, resolução da CEMAA, acaba por permitir ue metal pesado e nocivo à saúde seja despejado nos rios.

### **Cidade na Califórnia/EUA ganha rede de sensores de emissão**

O experimento será feito com 40 sensores - pequenos e de baixo custo - em um raio de 27 quilômetros quadrados.

### **Represa chinesa das Três Gargantas alcança pleno rendimento**

Hidrelétrica no rio Yangtsé teve sua construção criticada por ambientalistas chineses e estrangeiros.

### **Frente fria vai manter chuva no Sul do Brasil**

No Rio Grande do Sul, foram registrados grandes volumes nas últimas 24 horas, o que amenizou a estiagem.

### **Desmatadores da Amazônia Legal terão que pagar mais de R\$ 180 milhões em multa**

Cobrança é resultado de uma ação integrada entre a AGU e demais órgãos ligados ao combate a crimes ambientais.

### **Americanos se preocupam menos com mudança do clima, diz pesquisa**

Apenas 18% dos entrevistados apontaram problema global como prioridade. Levantamento foi feito por Universidade de Stanford em parceria com jornal.

### **Participantes da Rio+20 consideram Brasil preparado para grandes eventos**

De acordo com a pesquisa, 81% do público considera que, se depender dos serviços e infraestrutura turística, o Brasil está pronto para receber os eventos programados, que ainda incluem a Copa das Confederações e a Jornada Mundial da Juventude, ambas em 2013.

### **Produção residencial de energia solar já é economicamente viável para 15% dos lares brasileiros**

A produção de energia solar em grande escala (geração centralizada), no entanto, ainda é inviável, mesmo com incentivos governamentais.

### **Fóssil mostra que todos os dinossauros podem ter tido penas**

Descoberta feita na Alemanha pode ser a prova mais antiga de um dinossauro carnívoro com penas e sem ligação direta com as aves.

### **Abrigo no Entorno do DF tem onça 'atriz' e felino criado como bebê**

Instituto foi fundado após resgate de suçuarana que vivia em pequena jaula. Entidade gasta cerca de 45 kg de carne por dia para alimentar 28 animais.

### **Maior parte do Brasil enfrenta calor incomum para esta época do ano**

Quase não tem nuvens sobre o país. Com isso, os raios solares atingem a Terra com mais força.

### **Maior telescópio do mundo vai beneficiar Brasil, diz astrofísico**

O Brasil, após ter se transformado no primeiro país não europeu membro do Observatório Europeu Austral, participará do projeto, que precisará mais de dez anos de avaliações e estudos para confirmar sua viabilidade financeira e técnica.

### **China retira sopa de barbatana de tubarão dos banquetes oficiais**

Medida faz parte de campanha para reduzir despesas e também acata antigo pedido de grupos ambientalistas.

### **Cientistas da Espanha desvendam o genoma completo do melão**

Centros de pesquisa sequenciou DNA de sete variedades diferentes. Trabalho poderá permitir a produção de frutas mais resistentes a pragas.

### **Protesto contra usina poluente na China é reprimido por polícia local**

Confrontos foram registrados na cidade de Shifong, informa agência. Usina metalúrgica trataria metais pesados, como cobre e o molibdeno.

### **Parlamentares britânicos pedem proteção para indígenas brasileiros**

Moção proposta por 29 deputados pede mais pressão do governo britânico sobre o Brasil para reduzir ameaças à tribo Awá, no Maranhão.

### **Menor espécie de mosca do mundo é descoberta na Tailândia**

'Euryplatea nanaknihali' tem 0,4 milímetro de comprimento. Espécie seria capaz de parasitar formigas.

### **Inpa disponibiliza biblioteca virtual sobre sapos amazônicos**

Biblioteca foi criada para auxiliar na identificação das espécies. Criação da Sapoteca teve início há aproximadamente três anos.

### **Cientistas reprogramam células-tronco sem manipulação genética**

Método que usa líquido amniótico poderia ser alternativa a embriões. Pesquisadores esperam que, no futuro, técnica ajude na cura de doenças.

### **Título da Unesco aumenta responsabilidade para vencer desafios na área ambiental do Rio, diz Carlos Minc**

O título foi concedido no último final de semana pela Organização das Nações Unidas para a Educação, Ciência e Cultura, em votação realizada na cidade de São Petersburgo, na Rússia.

### **Argentina libera importação de carne suína brasileira**

A carne suína brasileira vinha enfrentando barreiras para entrar no território argentino desde fevereiro deste ano.

### **Centro da Antártica sofreria menos com temperatura maior, diz estudo**

Aquecimento causaria aumento na quantidade de nevascas na região. Com isso, temperatura no centro do continente seria 0,5°C menor.

### **Pesquisadores do Butantan desenvolvem anti-inflamatório capaz de aliviar dores crônicas**

Os primeiros testes em animais comprovaram a eficácia do medicamento, que usa uma proteína presente no sangue.

### **Projeto de santuário para baleias no Atlântico Sul é rejeitado em reunião**

Proposta apoiada pelo Brasil precisava de 75% dos votos, mas teve 65%. Intenção era criar área livre de exploração entre a América do Sul e África.

### **Brasil tem 680 mil pessoas morando em áreas de risco**

Entre os municípios já analisados estão dois considerados críticos no Acre, 58 nos nove estados da Região Nordeste e o restante em todos os estados do Sudeste e Sul do país.

### **Setor privado promove seminário para discutir o aproveitamento dos subprodutos da madeira para a produção de energia**

O VI Congresso Internacional de Desenvolvimento Econômico Sustentável da Indústria de Base Florestal e de Geração de Energia, o Madeira 2012, realizado em Vitória, com a participação de observadores do Ministério do Meio Ambiente.

### **Pesquisa mostra que mais britânicos apóiam o uso de energia nuclear**

Mesmo após Fukushima, 63% são a favor dessa forma de geração. Usinas eólicas, por outro lado, perderam apoio no Reino Unido.

### **Físicos dos EUA afirmam ter achado forte evidência da 'partícula de Deus'**

Dados do bóson de Higgs surgiram após testes no colisor Tevatron. Partícula seria responsável pelo surgimento da massa dos objetos.

### **País avança de forma sustentável e será vanguarda em águas ultraprofundas, diz professor**

A 31ª edição da International Conference on Ocean, Offshore and Arctic Engineering, que acontece até sexta-feira no Rio de Janeiro, terá como temas os oceanos, a exploração e produção de petróleo e gás nas áreas do pré-sal e o desenvolvimento das tecnologias offshore.

### **Região Sul registra 65 mortes de pacientes com o vírus Influenza H1N1 desde janeiro**

São 38 mortes em Santa Catarina, 14 no Paraná e 13 no Rio Grande do Sul.

### **Fóssil de dinossauro emplumado é encontrado na Alemanha**

O animal, chamado *Sciurumimus albersdoerferi*, é o "fóssil de megalossauro mais completo até agora". O fóssil pode ser de um dinossauro jovem do período jurássico, de 170 milhões de anos atrás.

### **Ativistas protestam na Alemanha contra pesca predatória nos oceanos**

Com 'escamas' e 'enroscados' em rede, manifesto ocorreu em Duesseldorf. Membros da ONG Peta alertam contra uso de redes de malha.

### **Comunidades tradicionais terão ajuda**

MMA oferece financiamento para projetos de fortalecimento e capacitação para a produção sustentável, gestão ambiental territorial e promoção e aprimoramento econômico do setor agroextrativista.

### **Países africanos querem implantar programa brasileiro de fortalecimento da agricultura familiar**

De acordo com informação do site do Ministério do Desenvolvimento Social e Combate à Fome, o objetivo do Programa de Aquisição de Alimentos é garantir acesso aos alimentos em quantidade, qualidade e regularidade necessárias às populações em situação de insegurança alimentar e nutricional, e promover a inclusão social no campo por meio do fortalecimento da agricultura familiar.

### **Clima pode reduzir tartarugas no Pacífico em 75% até 2100, diz estudo**

Aquecimento global e pesca atingem ovos e filhotes de espécie gigante. Projeções indicam anos mais quentes e secos na América Central.

### **Moradores fazem audiência para discutir ataques de onça-pintada no PR**

Animal é visto em propriedades de Santa Tereza do Oeste, no Paraná. Na reunião, foi criada uma comissão para acompanhar o

problema.

### **Rio recebe título de Patrimônio Cultural da Humanidade**

Chancela da Unesco garante mais políticas públicas para áreas turísticas. Votação do Comitê do Patrimônio Mundial da Unesco aconteceu na Rússia.

### **Estudo usa planta como anestésico para manejo de peixes no Amazonas**

Plantas como cipó-alho, cravo-da-índia e alfavaca estão sendo testadas. As substâncias foram testadas principalmente em tabaquis e matrinxãs.

### **Copenhague é escolhida Capital Verde Europeia 2014**

Cidade dinamarquesa desbancou concorrentes como Bristol na Inglaterra e Frankfurt na Alemanha.

### **Nova experiência tenta resolver mistério da Ilha de Páscoa**

Os cientistas estão mais próximos de descobrir como os moais foram transportados na ilha do Pacífico Sul.

### **Ignacy Sachs: desenvolvimento sustentável só é possível com intervenção do Estado no mercado**

O desenvolvimento ambiental não pode ser dissociado das questões sociais e econômicas.

### **Fundo florestal investirá até R\$ 2 milhões em fomento na Amazônia**

Serviço Florestal Brasileiro estima que mil pessoas serão beneficiadas pela iniciativa.

### **Animais chegam a morrer de fome em zoológico na Indonésia**

As organizações comprometidas com a proteção da fauna denunciam que no país o pior castigo que um animal pode sofrer é o de ser exibido no zoológico de Surabaya, situado no leste da ilha de Java e no qual há vários meses morrem uma média de 15 exemplares.

### **Nave russa Soyuz TMA-03M aterrissa com sucesso no Cazaquistão**

Cápsula tocou a terra na hora prevista e traz três astronautas. Tripulantes ficaram cerca de seis meses a bordo de plataforma orbital.

### **Maior lua de Saturno pode conter água líquida sob crosta de gelo**

Sonda Cassini, da Nasa, traz dados sobre a estrutura interna de Titã. Descoberta está descrita na edição desta semana da revista 'Science'.

### **Ibama: falta de qualidade técnica de projetos é um dos principais entraves para licenciamento**

Ao assumir o órgão há pouco mais de um mês, Volney Zanardi disse que, em muitos casos, as autorizações e licenças não esbarram em questões ambientais, mas na própria viabilidade desses projetos.

### **Pesquisadores descobrem primeira caverna vulcânica do país no Paraná**

Descoberta geológica fica em Palmital, no centro oeste do estado. Formação semelhante existe apenas no Hawaii, segundo especialistas.

### **Japão retoma atividades nucleares com reativação de usina**

Suspensão das atividades atômicas estava vigente no Japão desde 5 de maio.

### **Arun Gandhi defende mobilização social como forma de alcançar metas da Rio+20**

A avaliação do ativista tem como base a filosofia difundida pelo avô dele, o líder pacifista indiano Mahatma Gandhi, que defende a mudança a partir das pessoas e não dos governos.

### **Secretaria do Ambiente do Rio de Janeiro fecha fazenda por desmatar Mata Atlântica para plantar eucaliptos**

Localizada na área de proteção permanente (APP) do Rio Guandu, responsável pelo abastecimento de água da região metropolitana do estado, a plantação, no município de Miguel Pereira, no centro-sul fluminense, não estava de acordo com as normas legais estabelecidas pela Secretaria de Estado do Ambiente.

### **Novo presidente quer transformar Ibama em órgão de excelência na implementação de políticas ambientais**

O engenheiro químico, que deixou a direção do Departamento de Gestão Estratégica do Ministério do Meio Ambiente para conduzir o órgão ambiental, explicou que a proposta é "organizar a casa".

### **Ibama investiu mais de R\$ 30 milhões em obras de unidades descentralizadas, diz novo presidente**

O investimento beneficiou unidades do Ibama em capitais e no interior de pelo menos 11 estados, como o Acre, Amazonas, Espírito Santo, Mato Grosso e Mato Grosso do Sul, o Piauí e Goiás, além do Distrito Federal.

### **Astrônomos descobrem pulsar mais rápido já encontrado**

Objeto compacto e denso é formado durante a explosão de uma estrela. Corpo celeste estudado atinge até 10,5 milhões de quilômetros por hora.

### **Pescadores não precisarão renovar Registro Geral de Pesca**

Anteriormente, os trabalhadores da pesca precisavam renovar o registro a cada dois anos para continuar exercendo sua atividade pesqueira.

### **Animais resgatados são devolvidos à natureza pela Polícia Ambiental de RO**

Os bichos doentes e vítimas de maus tratos recebem cuidados veterinários. Apreensões são feitas por patrulhas urbanas e rurais.

### **Regularização ambiental é tema de oficina**

Técnicos de Furnas participarão do encontro. MMA espera, com isso, atrair mais um parceiro no processo de legalização de propriedades rurais.

### **Numa mesma tarde, Rio Grande do Sul tem sol, calor, chuva e vento forte**

Enquanto Porto Alegre teve o dia mais quente em junho desde 2006, no Chuí o volume de chuva atingiu quase a média mensal.

### **Greenpeace impede saída de pesqueiro com destino a Austrália**

Os ativistas prenderam o navio com correntes ao redor da hélice.

### **Arqueólogos descobrem pedaço mais antigo de cerâmica na China**

Fragmento de 20 mil anos de idade foi encontrado em caverna e pode ter sido usado para cozinhar com água.

### **Aranha viúva-marrom toma o lugar da viúva-negra nos EUA, diz estudo**

Espécie marrom só passou a viver no sul da Califórnia a partir de 2003. Estudo coletou amostras em 72 locais e viu que animais brigam por habitat.

### **Total de mortes por Influenza H1N1 na Região Sul sobe para 61**

São 38 mortes em Santa Catarina, 13 no Paraná e dez no Rio Grande do Sul.

### **Elefante-marinho é encontrado em praia no Sul de Santa Catarina**

Animal pode ter chegado à costa pelas correntes marinhas do Sul. Oceanólogo aconselha moradores a não se aproximar do animal.

### **Nave que levou 1ª chinesa ao espaço retorna à Terra, mas capota ao pousar**

A Shenzhou 9 aterrissou no norte do país. Apesar do forte impacto e sacudidas da nave, astronautas nada sofreram.

### **Expectativa de vida do brasileiro sobe 25,4 anos**

Média passou de 48 anos para 73,4 anos no comparativo de 1960 com 2010.

### **Terremoto de 6,3 graus sacode região chinesa de Xinjiang**

O epicentro do terremoto foi localizado a 151 quilômetros a sudoeste de Shihezi.

### **Pílula 'quatro em um' torna tratamento do HIV mais 'seguro, simples e eficaz'**

Novo medicamento evita que pacientes percam ou atrasem doses.

### **Seca faz DF declarar estado de emergência entre julho e setembro**

Declaração exige medidas para evitar incêndios florestais. Na segunda-feira, Defesa Civil deu orientações a chacareiros.

### **Parlamentares do Japão acham perigosos 24 de 50 reatores nucleares**

Quase metade deles tem falhas ou oferecem riscos importantes. Atualmente, 48 reatores estão parados no país por tempo indeterminado.

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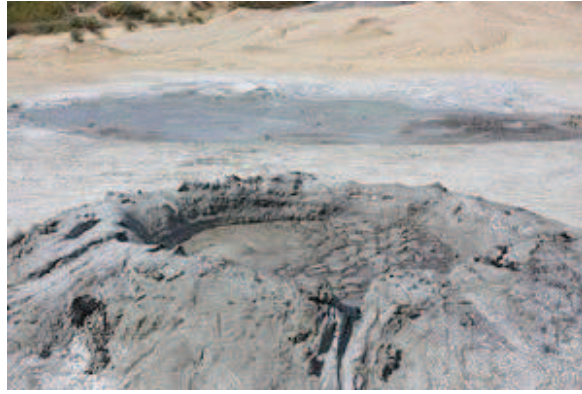
## EARTH PAGES

### **The Great Blurring**

Posted on [June 22, 2012](#) by [Steve Drury](#) | [Leave a comment](#)

It is hard to resist curiosity when a phrase includes a superlative. Dickens knew this when he opened *A Tale of Two Cities* with the words, ‘*It was the best of times, it was the worst of times...*’. So impacted into post-Victorian English language are they that the *Daily Mirror* of 13 May 2012 used them to celebrate ‘The most scintillating finish in Premier League history’: referring of course to the footballing tales of the city of Manchester (UK, that is). So it was with some gaiety that I turned to a paper in the May 2012 issue of *Geology* (Løseth. H. *et al.* 2012. World’s largest extrusive body of sand? *Geology*, v. 40, p. 467-470). Now, that is a title to conjure with, and I would advise any academic author to add a superlative adjective of some kind to their next manuscript title, to ensure more than 5 readers and at least one citation to add to her/his CV. Conversely, I caution against seemingly ultra-high impact, exclamatory single-word titles such as ‘*Coelocanth!*’, ‘*Porphyroblast!*’, ‘*Ignimbrite!*’ or ‘*Sphenochasm!*’: they summon untoward visions of geoscientists much given to snorting and pawing the air in salivating lust and groveling need, to plagiarise – yet again – Joseph Heller’s *Catch 22* (thus Heller described Hungry Joe’s reaction to a pornographic cameo brooch).

The sand body in question lies in the Pleistocene subsurface of the Norwegian sector of the North Sea above the Snorre oilfield, and came to light through a 3-D seismic survey with extraordinarily good resolution that allowed the reconstruction of its base and top structure contours (two-way time) and thus its overall volume and shape. At 10 km<sup>3</sup>, were it to have formed yesterday to cover Manhattan the paper’s abstract suggests that it would have reached the 37<sup>th</sup> floor of the Empire State Building. More parochially, had it engulfed the ‘Square Mile’ of the City of London (Post Codes EC1, 2, 3 and 4) 30 St Mary Axe (‘The Gherkin’) and ‘The Shard’ would be buried in their entirety leaving one of capitalism’s iconic heartlands a curiously gnarled sandy plain.



Small mud volcano, Romania (Photo credit: Wikipedia)

That the sand is extrusive rather than being simply a sedimentary stratum is revealed by its extraordinary shape. Its thickest part is in a depression surrounded by mounds of the underlying unit – the former seabed – above which the body is absent. These mounds show marginal signs on the seismic sections of dykes that could have acted as feeders from stratiform sands deeper in the sequence, the dykes coinciding with the base of ‘ditches’ in the body’s upper surface. In turn, the ditches have flanking ridges as if the ditches and the dykes below were feeders for the sand extrusion. Such an extrusive sand body is currently forming at the accidentally triggered Lusi sand volcano in Indonesia where a single vent exudes about 50 thousand m<sup>3</sup> each day; a rate that would take 550 years to produce the Snorre field body. Pleistocene stratigraphy surrounding the vast North Sea ‘boil’ suggests that it formed during a period of rapid sedimentation from the huge North Sea ice shelf supplied by the Scandinavian ice sheet. Helge Løseth and colleagues from Statoil and the University of Rennes ran a series of dry sandbox experiments to mimic the process of sand injection. By pumping air through interbedded sand, glass ballotini and silica powder, to represent two types of non cohesive sands and cohesive mudrocks, they found that increasing the overall air pressure in the box eventually fluidized the ‘sands’ which blurted through the ‘clays’ to form ‘volcanoes’ with plumes of sand that enlarged the area of deposition at the surface. Cutting into the sediments after the experiments revealed a remarkably real-looking system of intrusive sand bodies (dykes, sills and laccoliths) as well as the extrusive mass of sand. Chances are that such bodies may form more commonly in marine sequences, given encouraging over-pressuring through sudden increases in normal sedimentation. If so, the very open grain structure of the vented sands might provide superb petroleum reservoir characteristics.

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- [It’s enough sand to bury Manhattan...](#) (msnbc.msn.com)

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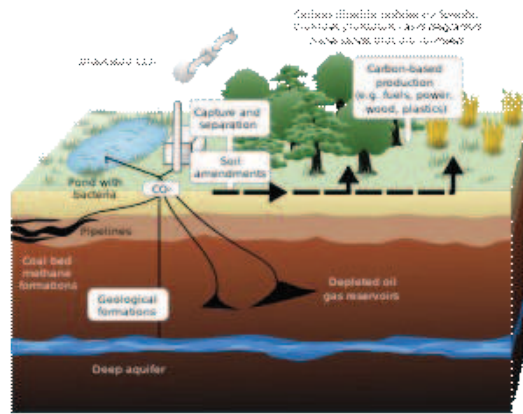
Posted in [Sedimentology and stratigraphy](#)

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### **Carbon dioxide burial: an analogy of some pitfalls**

Posted on [June 21, 2012](#) by [Steve Drury](#) | [Leave a comment](#)





geological sequestration of carbon dioxide emissions from a coal-fired power plant. (Photo credit: LeJean Hardin and Jamie Payne Wikipedia)

Of all the ‘geoengineering’ approaches that may offer some relief from global warming pumping CO<sub>2</sub> into deep sedimentary rocks, through carbon capture and storage (CCS) is one that most directly intervenes in the natural carbon cycle. In fact it adds an almost wholly anthropogenic route to the movement of carbon. It is difficult if not impossible for natural processes to ‘pump’ gases downwards except when they are dissolved in water and most often through the conversion of CO<sub>2</sub> to solid carbonates or carbohydrates that are simply buried on the ocean floor. Artificially producing carbonate or organic matter on a sufficient scale to send meaningful amounts of anthropogenic carbon dioxide to long-term rock storage is pretty much beyond current technology, but gas sequestration seems feasible, if costly. The main issues concern making sure geological traps are ‘tight’ enough to prevent sufficient leakage to render the exercise of little use and to understand the geochemical effects of large amounts of buried gas that would inevitably move around to some extent.

The geochemistry is interesting as reactions of CO<sub>2</sub> with rock and subsurface water are inevitable. The most obvious is that solution in water releases hydrogen ions to create weakly acidic fluids: on the one hand that might be a route for precipitation of carbonate and more secure carbon storage, through reaction with minerals (see <http://earth-pages.co.uk/2012/04/10/possible-snags-and-boons-for-co2-disposal/>), but another possibility is increasing solution of minerals that might eventually cause a trap to leak. A counterpart of pH change is the release of electrons, whose acceptance in chemical reactions creates reducing conditions. The most common minerals to be affected by reducing reactions are the iron oxides, hydroxides and sulfates that often coat sand-sized grains in sedimentary rocks, or occur as accessory minerals in igneous and metamorphic rocks. Iron in such minerals is in the Fe-3 valence state (*ferric* iron from which an electron has been lost through oxidation) which makes them among the least soluble common materials, provided conditions remain oxidising. Flooding sedimentary rocks with CO<sub>2</sub> inevitably produces a commensurate flow of electrons that readily interact with Fe-3. The oxidised product Fe-2 (*ferrous* iron) is soluble in water, and so reduction breaks down iron-rich grain coatings. Much the same happens with less abundant manganese oxides and hydroxides. One important concern is that iron hydroxide (FeO.OH or goethite) has a molecular structure so open that it becomes a kind of geochemical sponge. Goethite may lock up a large range of otherwise soluble ions, including those of arsenic and some toxic metals. Should goethite be dissolved by reduction that toxic load moves into solution and can migrate.



Bleached zone with carbonate-oxide core in Jurassic Entrada Sandstone, Green River, Utah. (Image: Max Wigley, University of Cambridge)

Except where deep, carbonated groundwater leaks to the surface in springs – the famous Perrier brand of mineral water is an example – it is difficult to judge what is happening to gases and fluids at depth. But their long-past activity can leave signatures in sedimentary rocks exhumed to the surface. Most continental sandstones, formed either through river or wind action, are strongly coloured by iron minerals simply because of strongly oxidising conditions at the Earth's surface for the past two billion years or more. Should reducing fluids move through the, the iron is dissolved and leached away to leave streaks and patches of bleached sandstone in otherwise red rocks. In a few cases an altogether more pervasive bleaching of hundreds of metres of rock marks the site of massive fluid-leakage zones. Terrestrial Mesozoic sedimentary sequences in the Green River area of Utah, USA exhibit spectacular examples, easily amenable to field and lab study (Wigley, M. *et al.* 2012. Fluid-mineral reactions and trace metal mobilization in an exhumed natural CO<sub>2</sub> reservoir, Green River, Utah. *Geology*, v. **40**, p. 555-558). There the bleaching rises up through the otherwise brown and yellow sandstones, cutting across the bedding. In the bleached zone, secondary calcite fills pore spaces. At the contact with unbleached sandstone there are layers of carbonate and metal oxides, enriched in cobalt, copper, zinc, nickel, lead, tin, molybdenum and chromium: not ores but clear signs confirming the general model of reductive dissolution of iron minerals and movement of metal-rich fluid. Carbon isotopes from the junction are richer in <sup>13</sup>C than could be explained by the gas phase having been methane, and confirm naturally CO<sub>2</sub> - rich fluids.

So, Green River provides a natural analogue for a carbon capture and storage system, albeit one that leaked so profusely it would be a latter day disaster zone. In that sense the site will help in deciding where not to construct CCS facilities.

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- [Earthquake risk for carbon capture and storage schemes](#)(newscientist.com)
- Fessenden, J. 2012. Carbon sequestration and natural analogs.*Geology*, v. **40**, p. 575-576

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### **Disputes in the cavern**

Posted on [June 14, 2012](#) by [Steve Drury](#) | [Leave a comment](#)

If Ignatius Loyola been a child of the late 20<sup>th</sup> century, it is quite likely that he would have chosen palaeoanthropology as a career rather than theology, seeing as he was so predisposed to casuistry. When I innocently asked a vertebrate palaeontologist who specialized in the Pliocene and Pleistocene Epochs why it was that students of hominins were so prone to controversy, his answer was revealing: 'They don't have many fossils'. One place where there are lots of hominin fossils, in fact the largest known sample



of them, is the Atapuerca cavern in northern Spain. At the deepest level of the cave system there is a veritable charnel house containing the remains of at least 28 individuals. Because there are bones from all parts of the human anatomy, some have suggested that the cache is one of deliberate burial, but there is a disturbing dearth of the smaller bones of feet and hands. Consequently, other voices claim that the bodies were washed in by floods, losing extremities en route – though that view would be easily tested using other signs of trauma on large bones. Yet that is a minor quibble compared with one that is developing around the context of the age of the boneyard and the taxonomy of the cadavers in it (<http://www.guardian.co.uk/science/2012/jun/10/fossil-dating-row-sima-huesos-spain>).



Head of *Homo heidelbergensis*, Senckenberg Museum, Frankfurt am Main, Germany (Photo credit: Wikipedia)

The Spanish team responsible for the evolutionary wealth of the entire Atapuerca cave complex, which ranges from almost a million years ago to recent times, assigned the Sima de los Huesos (Pit of Bones) fossils to *Homo heidelbergensis*. In fact about 90% of all *H. heidelbergensis* remains are from Atapuerca, so any anatomical dispute over these specimens is a threat to the status of the species itself. One leading authority who does dispute this assignment is Chris Stringer of the UK Natural History Museum, who claims that many of the heads have teeth and jaws with shapes that fall within the range of Neanderthals – supposedly descended from *H. heidelbergensis*. The age of the deposit is the focus of debate. Were it to be around 400 ka or younger, as early attempts at dating suggested, then the fossils might well be those of Neanderthals for that is early in the range of that species as determined by ‘molecular-clock’ studies of Neanderthal DNA. However, the material most likely to yield a good radiometric age is carbonate speleothem, the stuff of stalactites and stalagmites though more commonly a matrix that binds old cave detritus. The fossils are undoubtedly far older than the maximum age that can be achieved using the well known radiocarbon method (<60 ka), but speleothem lends itself to a precise dating technique based on the decay series of uranium isotopes. In the case of Sima de los Huesos, the fossils lie in a clay breccia overlain by a layer of speleothem, which has yielded a U-series age of around 600 Ma (Bischoff, J.L. *et al.* 2007. High-resolution U-series dates from the Sima de los Huesos hominids yields 600 kyrs: implications for the evolution of the early Neanderthal lineage. *Journal of Archaeological Science*, v. 34, p. 763-770).



The ‘bone breccia’ in Sima de los Huesos, Atapuerca caverns Spain (from Bischoff, J.L. *et al.* 2007)



Neanderthal head from Israel (Wikipedia)

Stringer argues that the hominins' anatomy is so like that of Neanderthals that, somehow, the radiometric age must be wrong – i.e. too old – perhaps because the speleothem is in fact from a 600 ka block that fell onto the fossils after they had accumulated. His view is that they are Neanderthals descended from *H. heidelbergensis* living in the earlier Pleistocene and which was the common ancestor of both Neanderthals and anatomically modern humans. Bischoff, J.L. *et al.* consider the Sima de los Huesos hominids to be 'at the very beginnings of the Neanderthal evolutionary lineage', which seems to me to be a reasonable deduction from both stratigraphic and anatomical data. To demand that they must be at least 200 ka younger, apparently on the basis of an estimate of Neanderthal origination from DNA data seems less reasonable. The appearance of Stringer's detailed arguments in *Evolutionary Anthropology* (v. **21**(3)) is eagerly awaited, following the *Observer's* take on his position.

Another area in which controversy is brewing – and has been for decades – is that of the origin of human artistic culture. One of the gem-boxes of early art is the Geissenclösterle (monastery of the goats) cavern in southern Germany, in which have been found various figurines made of bird bone and ivory, including a celebrated lion-man theriomorph, highly exaggerated female figures, flutes and beads. They belong to the Aurignacian culture brought by the earliest anatomically modern Europeans who diffused westwards along the Danube from the near-East as early as 45 ka ago. The layer containing the artifacts was originally dated at about 35 ka, but new radiocarbon techniques have been tried on bone with cut marks, among other materials (Higham, T. *et al.* 2012. Testing models for the beginnings of the Aurignacian and the advent of art and music: the radiocarbon chronology of Geissenclösterle. *Journal of Human Evolution*, v. **62**, p. 664-676 doi:10.1016/j.jhevol.2012.03.003) and found to yield a much older age of 42.5 ka, close to the oldest European date for modern human occupation 43-45 ka for the stratigraphically older Uluzzian tool industry.



Lion-man sculpture from Geissenclösterle ( J. Duckek Wikipedia)

The date is also considerably earlier than the demise of the Neanderthals and raises the issue of modern-Neanderthal contacts. Indeed the layer below that assigned to Aurignacian contains tools made by Neanderthals, whose age is statistically indistinguishable from the later occupation level. The Chatelperronian tool industry, which closely resembles the Aurignacian but is ascribed to Neanderthals, is supposed to be around 40 ka old, but the advanced radiocarbon technique that yielded much older ages for Geissenclösterle apparently has not yet been deployed on this culture. On the basis of limited age data, it does seem likely that Neanderthals adopted the new technology after they encountered it. The Aurignacian artistic products are vastly more advanced than any found at older sites in Africa.

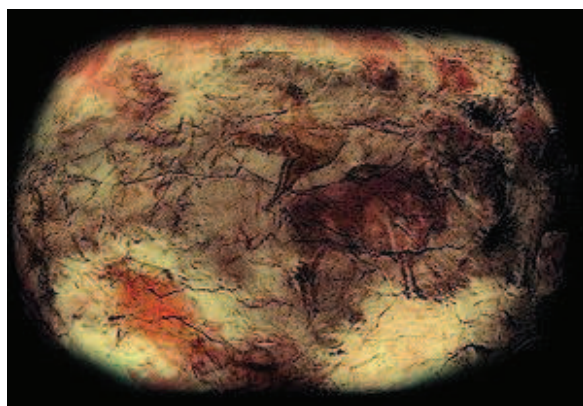


Aurignacian female figurine from near Geissenclösterle..(Silosarg: Wikipedia)

In the context of the debate about modern human and Neanderthal cognitive abilities, which suggests the former were altogether smarter and more creative, there is an unvoiced or at least unheeded argument. Whether or not Neanderthals originated artifacts that were ‘modern’ for their time or copied them is not as important as the fact that this group, previously isolated for up to 400 millennia, were able to appreciate and learn these novelties. That is much the same as people living today, in Australia for instance, a couple of generations from hunter-gatherer origins, working on production lines, piloting aircraft, social networking and creating world-class abstract art. What did they, and the Aurignacians, produce from other materials that have not survived decay; ditto for

any pre-45 ka humans? Another point rarely raised, but surely valid, is that previous people may not have felt any need to produce art in forms that survive for tens or hundreds of millennia. Forty-odd thousand years ago, climate was undergoing rapid ups and downs of temperature and humidity in the run-up to the last glacial maximum. Conditions at mid-latitudes would have been much more changeable than those of the tropics. Both anatomically modern humans and Neanderthals faced the same attendant ecological changes, and they faced each other as occupants of southern Europe and as rivals for available resources. Finally, Aurignacians hailed from the east, also cohabited by Neanderthals and severely affected by rapid climate change from around 80 ka, so did they bring with them a culture formed elsewhere? Europe concentrates palaeoanthropologists and their endeavours, while much of the planet to which humans diffused from Africa – and Africa itself – are grossly under-investigated by comparison: ideas will undoubtedly change drastically as these areas get the attention they deserve.

Controversy is not a problem. Indeed, with imperfect, inadequate or ambiguous data it is unavoidable, and heated disputes spur the search for more information that can help resolve ideas or change them. What cannot be sidestepped is the potential for havoc that may arise with new and improved methods. In both cases outlined here radiometric dates have thrown the proverbial spaniel into the works. That used in the Geissenclösterle cavern was designed to remove younger contaminating material from samples for radiocarbon dating and inevitably tends to push  $^{14}\text{C}$  dates further back in time. By removing a source of inaccuracy it highlights the inadequacies of dates obtained by earlier approaches on which a great deal of current archaeology thinking relies. How much younger contamination is present in a sample only emerges after the improved dating: it may be absent or substantial. So, until dates produced by earlier radiocarbon methods are redated neither their absolute values nor their relative sequence in time can be considered reliable.



Art on the walls of Altamira Cave, northern Spain, including both older abstract works and younger figurative depictions of prey animals (Photo credit: Wikipedia)

Results from just such an advance in radiometric dating of cave deposits in northern Spain will really cause a stir, when they sink in (Pike, A.W.G. and 10 others 2012. U-series dating of Paleolithic art in 11 caves in Spain. *Science*, v.336, p. 1409-1413). The U-series method used at the University of Bristol by the joint British-Spanish collaborators dates calcite deposits on painted cave walls, including those at the famous Altamira site. This speleothem or ‘flowstone’ may underlie artwork or may have grown over it after completion, giving maximum and minimum ages for the painting, respectively. If a work has flowstone underneath and as a coating, dating potentially ‘brackets’ a possible age range. The superb figurative depictions of various prey animals, such as bison in Altamira cave, turn out to have been painted around at around 18 ka, during the last glacial maximum. However a lot of the art is abstract, such as hands surrounded by red pigment presumably sprayed onto the wall from the artist’s mouth, various stippled discs and dots. Many of the latter are beneath flowstone that is around twice as old as the more familiar objects and range in age from 34 to 41 ka, thereby being close in time with the Geissenclösterle materials. Like them, their ages may coincide with the arrival of the earliest anatomically modern Europeans, but they are also towards the end of the period when Neanderthals were still present in much of Europe, including northern Spain. It cannot be ruled out therefore that the earliest paintings were Neanderthal

symbolic art.

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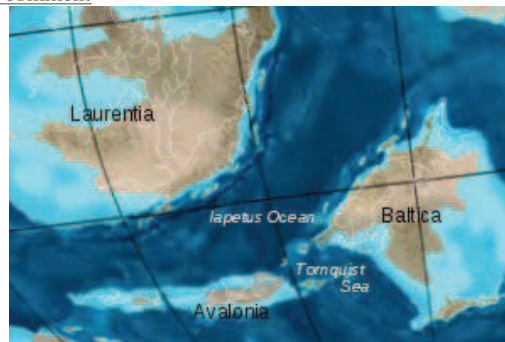
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## When Iapetus opened

Posted on [June 7, 2012](#) by [Steve Drury](#) | [Leave a comment](#)



The Iapetus Ocean separating the paleocontinents of Baltica, Laurentia and Avalonia about 460 million years ago. (Rob Blakey <http://jan.ucc.nau.edu/~rcb7/>, Wikipedia)

The first sign that there was something odd about the Lower Palaeozoic in NW Europe and North America stemmed from gross mismatches between fossil assemblages only a few tens of kilometers apart across the regional strike of sedimentary rocks older than the Upper Silurian. It didn't show up in the Devonian and Carboniferous, and nothing like it reappeared until well into the Jurassic. Until the 1960s the separation of these faunal provinces was ascribed to something akin to the [Wallace Line](#) that currently separates the flora and fauna of Oceania, Australia and the eastern islands of Indonesia from those of western Indonesia and Asia: a barrier to migration presented by the deep-water but narrow channel between Bali and Lombok in the Indonesian archipelago. The ancient biological boundary roughly coincides with the long-described Caledonian and Acadian Orogens of NW Europe and eastern North America respectively. With the discovery of plate tectonics another explanation arose: that formerly the opposite sides of the once contiguous orogens had been separated by thousands of kilometers across a former ocean. This was named in 1966 by [John Tuzo Wilson](#) after Iapetus, one of the mythical Greek titans who fathered Atlas – the eponym of the Atlantic Ocean. So, in the tectonic canon, the Caledonian-Acadian mountain belt marks the closure through subduction of its former oceanic lithosphere which brought the distinct faunal provinces together across a line known as the [Iapetus Suture](#). Many lines of evidence time-stamp this continental collision to the end of the Silurian Period.





The Iapetus Suture, marked by the Niarbyl Fault on the Isle of Man. One of few places one can believably straddle two ancient continents. (G.J Kingsley at Wikipedia)

When the Iapetus Ocean began to open is not so easy to pin-point, save that it predated the Cambrian Period. The most likely possibility is that it marked the line of separation between fragments of the 1 billion-year old Rodinia supercontinent, which started to break up in the early Neoproterozoic. That was a protracted event, palaeomagnetic, radiometric and stratigraphic data loosely constraining extension between the former two sides of Iapetus to between 620 and 570 Ma. Around Quebec City, Canada are a number of large faults in the St Lawrence rift system that bound a zone of deep water sediments and volcanic rocks that yielded this broad age range. Yet the faults are associated with glassy rocks formed by frictional melting during brittle fracturing. These pseudotachylites can be dated, and have now helped resolve the ‘fuzziness’ of Iapetus’s formation (O’Brien, T.M. & van der Pluijm, B.A. 2012. Timing of Iapetus Ocean rifting from Ar geochronology of pseudotachylites in the St Lawrence rift system of southern Quebec. *Geology*, v. **40**, p. 443-446). The two co-workers from the University of Michigan show that the rifting occurred between 613 and 614 Ma, coinciding with a brief period of mafic dyke emplacement in Newfoundland and Labrador. Since the Iapetus Suture occurs not far away from the St Lawrence rift system in eastern Canada the area has now become the best constrained example of what soon became known in the early days of plate tectonics as a Wilson Cycle, representing rift, drift and collision. John Tuzo Wilson (1908-1993), a Canadian descended from French and Scottish settlers, and a pioneer of the modern phase of geology, would be pleased it had finally homed in on terrain he knew well.

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## **Early origins of meat and two veg**

Posted on [June 1, 2012](#) by [Steve Drury](#) | [Leave a comment](#)



(Photo credit: Wikipedia)

When and how humans acquired fire on demand and began to cook has long engaged story tellers and historians. Entertaining tales are those of the titan Prometheus, who stole fire from Zeus and then had his liver eaten by an eagle (<http://en.wikipedia.org/wiki/Prometheus>), and of Bo-bo, who accidentally discovered the barbecue approach to the meat of pigs

([http://www.amazingribs.com/BBO\\_articles/dissertation\\_on\\_roast\\_pork.html](http://www.amazingribs.com/BBO_articles/dissertation_on_roast_pork.html)). Despite the secretive pleasures of some French and Ethiopian gourmets, raw flesh is not widely appreciated, although a rare steak comes pretty close. There is nothing wrong with it apart from its usually being tough and prone to deliver spectacular evacuations. Cooking unfolds the proteins in meat making them easier to digest and therefore portions of cooked meat deliver higher nutrition than they would direct from the carcass. Likewise, cooking some vegetables, especially various tubers, breaks down their chemistry to more easily digested and more palatable materials: think ‘potato’ in this context. In fact many potentially nutritious tubers are positively toxic if not processed and cooked, classic examples being cassava and wild yams.

While some anthropologists consider a change in hominin habits to eating meat *per se*, probably originally as carrion, as the necessary step to a leap in nutrition from which an enlarged brain developed, others favour the harnessing of fire and the invention of cooking that released greater proportions of proteins and carbohydrates from available foodstuffs. Since hominins evolved in distinctly seasonal savannas and open woodland, the shortage of game and directly edible above-ground plant parts in the dry season suggests indirectly that our early ancestors had two possible survival paths open to them: powerful jaws and complex digestive tracts to survive on woody stems or digging up tubers. Respectively, the anatomy and tooth-wear patterns of paranthropoids and early *Homo* to some extent support such a dichotomy that arose from the australopithecines after about 2 Ma ago. Both succeeded and cohabited roughly the same ranges in eastern Africa for as long as a million years.

So pinning down the origin of controlled use of fire is a major goal of Pleistocene archaeology to settle the issue of nutrition and brain growth. Also, it would help explain how hominins were able to diffuse far beyond their home ranges to northern latitudes sufficiently high to place fire as an essential source of warmth at night and in winters. Yet, evidence for habitual use of fire is younger than 400 thousand years among *H. heidelbergensis*, *H. neanderthalensis* and *H. sapiens*, literally leaving the wide roaming *H. erectus* to shiver as far as scientific proof of hearth and home is concerned. There have been claims of early charring, burnt bones and ashes but until recently such evidence has been ambiguous, largely because fire can start easily and naturally in tinder-rich conditions. There are now, however, advanced microscopic, chemical and physical techniques for estimating temperatures to which bones have been subjected and detecting changes in materials caused by fire, which can be applied to minute samples from sites once occupied by earlier people. One test site for the methods has been the Wonderwerk Cave in South Africa that is known from Acheulean tools and cut bone to have been occupied as long ago as 1.1 Ma. They gave a positive result for the use of fire by the earliest cave occupants (Berna, F, *et al.* 2012. Microstratigraphic evidence of in situ fire in the Acheulean strata of Wonderwerk Cave, Northern Cape province, South Africa. *Proceedings of the National Academy of Science USA*, [www.pnas.org/cgi/doi/10.1073/pnas.1117620109](http://www.pnas.org/cgi/doi/10.1073/pnas.1117620109) – open access). The same methods had previously been used to establish controlled human use of fire around 400 ka in once occupied caves in Israel, but at Wonderwerk almost triple the age of earliest known use. But they have refuted similar claims from the famous Zhoukoudian site of ‘Peking Man’ (Asian *H. erectus*) (<http://www.unesco.org/ext/field/beijing/whc/pkm-site.htm>).

A useful adage is that ‘the absence of evidence is not evidence of absence’, and it is early days for the routine archaeological use of micromorphology, Fourier transform infrared (FTIR) spectroscopy in the search for human embers. In drylands naturally started fires, either as a result of lightning or spontaneous combustion, are so common that hominins would have been well aware of them, their dangers and perhaps their advantages as regards a free barbecue. Possibly Bo-bo’s salivating at the aroma of roast pig from the wreckage of his father house that he had razed to the ground though sheer stupidity would have struck some early hominins as a useful connection between a lucky feast and the still glowing embers of a bush fire. With care, embers can survive for long enough to be carried and used to start controlled fire; a fact not lost on many surviving fully human foragers, and also kids on a South Yorkshire council estate eager for the delights of roasting some ‘borrowed’ potatoes.

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## **Groundwater in Africa**

Posted on [May 23, 2012](#) by [Steve Drury](#) | [1 Comment](#)

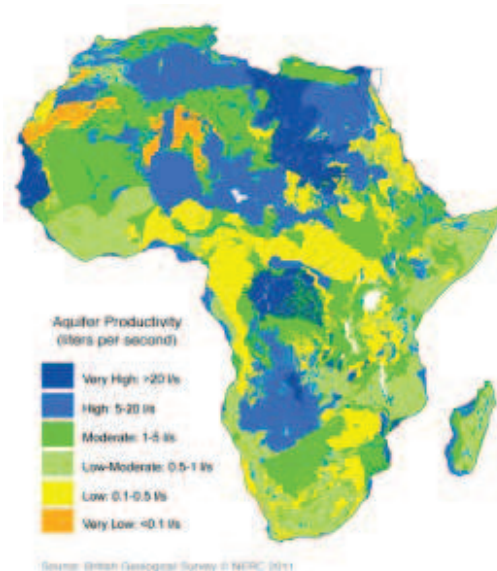


Drinking water for many rural Africans often comes from open holes dug in the sand of dry riverbeds, and it is invariably contaminated. (Bob Metcalf on Wikipedia)

Sub-surface water supplies have rarely, if ever, figured in *Earth Pages* except in passing or in relation to the on-going crisis of arsenic pollution in drinking-water supplies. That is largely because of the paucity of [groundwater](#) publications that have a general interest. So it was welcome news to learn that hydrogeologists of the British Geological Survey and University College London have produced a continent-wide review of groundwater prospects for Africa, probably in most need of good news about water supplies (MacDonald, A.M. *et al.* 2012. Quantitative maps of groundwater in Africa. *Environmental Research Letters*, v. 7 [doi:10.1088/1748-9326/7/2/024009](#). They used existing hydrogeological maps, publications and other publically available data to estimate total groundwater storage in a variety of aquifer types and the yield potentials of boreholes. Details can be seen at [www.bgs.ac.uk/research/groundwater/international/africanGroundwater/maps.html](http://www.bgs.ac.uk/research/groundwater/international/africanGroundwater/maps.html)

Dominated by the vast sedimentary aquifers of Libya, Algeria, Egypt and Sudan, such as the [Nubian Sandstone](#), around 0.66 million km<sup>3</sup> may lie below the continental surface: more than 100 times the annually renewable freshwater resources, including the flows in three of the world's largest rivers, the Nile, Congo and Niger. Though only a fraction of this subsurface potential may be available for extraction through wells, the arithmetic, or rather the statistics, suggest that small diameter boreholes and simple handpumps, as well as traditional wells, can sustainably satisfy the drinking water needs of the bulk of Africa's rural populations with yields of individual wells between 0.1 to 1 l s<sup>-1</sup>. However, groundwater use in irrigation and for large urban supplies demands well productivities an order of magnitude higher from thick sedimentary sequences, which rarely coincide in Africa with areas suitable for large-scale agriculture or existing cities and large towns. Both the humid tropical lowlands with thick unconsolidated sediments and the deep [sedimentary rock](#) aquifers beneath the Sahara and other arid areas match great groundwater potential with either little need for groundwater or virtually no potential for agricultural development and very few people. Moreover, the truly vast reserves of North Africa that are an order of magnitude or more greater than in any other countries are at such depths and so remote that development needs commensurately huge investment, in the manner of oil-rich Libya's Great Man Made River Project projected at more than US\$25 billion investment. To say that reserves, convenience and yields are inequitably distributed in Africa would understate the hydrogeological difficulties of the continent.





Average well productivity predicted by MacDonald et al from Africa's regional geology

Much of Africa has crystalline basement at the surface that has useful yields ( $>0.1 \text{ l s}^{-1}$ ) only when deeply weathered, and even then rarely yields better than  $1 \text{ l s}^{-1}$ . An exception to this general rule is where basement has been shattered by large faults and fractures. Sedimentary cover is generally thin across the continent and with highly variable yield potential. The other issue is that of sustainability, for if extraction rates exceed those of recharge then groundwater effectively becomes a non-renewable resource. About half of the African surface, mainly in its western equatorial region, has sufficient rainfall and infiltration potential to outpace universally high evapo-transpiration to give recharge rates of more than 2.5 cm of annual rainfall. For all the areas repeatedly hit by drought and famine, average recharge through the surface that escapes being literally blown away on the wind is less than half a centimetre.

To have synopses of all the important issues surrounding African groundwater – the best choice for safe domestic supplies in hot, poor areas – would seem to be very useful to those engaged in development and relief strategies; i.e. to governments, the UN ‘family’ and World Bank. But there are important caveats. An obvious one is the antiquity of many of the surveys drawn on by MacDonald *et al.* Some 23 out of 33 were published more than 20 years ago using data that may be a great deal older: such has been the snail-like pace of publication by all geological surveys, including BGS. That is compounded by the small scale of the maps (mainly smaller than 1:1 million) and the extremely sparse geophysical data concerning subsurface geology across most of Africa. ‘Quantitative’ is not the adjective to use here, for unlike in most of the developed world, groundwater reserves and locations in Africa have not been measured, but estimated from pretty meagre data. In fact to be brutally realistic, most of the source maps are based on educated guesswork by a few hard-pressed geoscientists once personally responsible for areas that would cripple most of their colleagues working in say Europe or North America.

If there is a truism about water exploration in Africa, outside the well-watered parts, it is this: sink a well at random, and it will probably be dry. The stats may well be encouraging, as MacDonald *et al.* clearly believe, but finding useful groundwater supplies relies on a great deal more. Outside cities, people survive as regards groundwater often as a result of traditional means of water exploration and well digging: they or at least some locals are experts at locating shallow sources. Yet to improve their access to decent water in the face of both rising populations and climate change demands sophisticated exploration techniques based on geological knowledge. Most important is to ensure supplies to existing communities, whose locations do not necessarily match deeper groundwater availability, bearing in mind that a universal problem for most African villagers is the sheer distance to wells with safe water. Rigs used to drill tube wells are expensive to hire, so the likelihood of success needs to be maximised. In the absence of large-scale (1:50 000) geological maps – rarities throughout Africa – only skilled hydrogeological interpretation of aerial or satellite images followed-up by geophysical ground traverses offer that vital confidence.



Geologically useful ASTER image of the Danakil Block in Eritrea/Ethiopia, showing Mesozoic and Recent sedimentary aquifers and crystalline basement (Steve Drury)

In fact, thanks to the joint US-Japan ASTER system carried in sun-synchronous orbit, geologically-oriented image data are available for the whole continent. Interpretation requires some skills but few if any beyond learning in a practical, field setting. Indeed, the African surface in its arid to semi-arid parts most at risk of drought and famine, lends itself to rapid hydrogeological reconnaissance mapping using ASTER data. Given on-line training in image interpretation, a ‘crowd-source’ approach coordinating many interpreters could complete a truly life-giving and easily available map base for local people to focus their own well-construction programmes.

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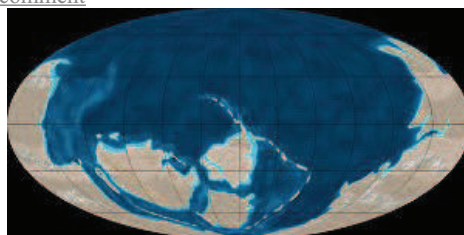
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**Origin of the arms race**

Posted on [April 30, 2012](#) by [Steve Drury](#) | [Leave a comment](#)



Global paleogeographic reconstruction of the Earth in the early Cambrian period 540 million years ago. (credit:Ron Blakey, Northern Arizona University)

Palaeontologists generally agree on one broad aspect of animal evolution: the central role of predation versus defence in animal diversification to occupy different ecological niches. Indeed that co-relation has to an extent been responsible for the diversification of potentially habitable niches themselves. Armour and arms form a dialectic within the animal world, but one that only rose to dominate when hard materials became an integral part of animal morphology, allowing some to bite, gnaw or rasp and others to develop shelly or horny skeletons. The Kingdom Animalia within the domain of the eukaryotes – organisms based on cells that bear a nucleus – is united by one life style, that of feeding directly or indirectly on other living things. They are heterotrophs unable to generate energy and tissue through the fundamental harnessing of chemistry and physics to use the inorganic world directly, as do autotrophs. One of the earliest discoveries about the history of animals was that fossils in the widely accepted meaning of the word

appeared suddenly in the geological record, earlier rocks containing virtually no tangible signs of life: fossils explode in numbers from the start of the Cambrian Period at 542 Ma. Subsequently, geologists did discover imprints of clearly quite complicated organisms in rocks a few tens of million years older than the start of the Cambrian. But these were flaccid, bag like creatures that recent research has shown to rely on filtering microorganisms from water or directly absorbing organic matter through their skin.



An animal from the late Precambrian(Photo credit: Wikipedia)

Another feature of sediments of the oldest Cambrian is that in many parts of the world they rest with or=profound unconformity on deformed older rocks of Precambrian age. Throughout Britain the lowest Cambrian rocks are almost pure quartz sandstones that rest upon older more complex rocks ranging from only a few tens of million years older than 542 Ma to some of the oldest rocks in Europe, the Lewisian complex dating back 3 billion years. Many of the hills of North West Scotland have a gleaming white cap of Lower Cambrian quartzite above what has been termed the Great Unconformity where it occurs in Arizona's Grand Canyon. Sedimentary sequences that continuously record the Precambrian to Cambrian transition and the biological explosion at the juncture are rare. But they show two curious features in sediments that immediately predate those bearing recognisable fossils: a complete lack of evidence for burrowing and millimetre-scale shell-like bodies made of calcium phosphate and carbonate, which are thought to have adorned the skins of otherwise unprotected animals.



Creatures from the Cambrian Period (credit: Wikipedia)

Calcium, while a very common element is one of the most dangerous to life. Traces are essential for the signalling that goes on in cell metabolism, and too little snuffs out those vital processes. Yet too much – still a very low concentration in cell cytoplasm – results in the growth of minute mineral crystals within cells, also spelling cell death. This results from the limited solubility of calcium in water, compared with those of other common metals. At an early stage in evolution cells developed means of restricting the admission of calcium ions and efficient means of expelling excess amounts of calcium. The ubiquitous occurrence of Ca-rich marine limestones throughout the geological record bears witness to two things: the abundance of calcium ions in seawater; a closer look reveals that a great many limestones, going back some 3.5 billion years show traces of biomineralisation that helped form the limey sediments. In the second case, the calcium carbonate in most Precambrian limestones was secreted by photosynthetic blue-

green bacteria in minutely thin layers, probably in the form of a slimy film excreted to avoid calcium toxicity. Palaeontologists have long suspected that the earliest skeletal materials formed by animals evolved from the need to excrete biomineralised films by turning a metabolic necessity into functional and integral parts of their body plans: arms and armour. Yet limestones are not rare signs of the presence of a dissolved calcium threat, so why the sudden adoption of waste products in this way?

A fairly old hypothesis is that calcium in seawater must have risen above a threshold that posed toxic threat to all living things and excretion had to increase to maintain the balance, perhaps matched with increasing sizes of animals in the late Precambrian. Only recently has support been found for this suggested evolutionary trigger, initially from analysis of brines trapped in crystalline materials within sediments, such as salt (NaCl). But the very presence of such halite in a sediment is a universally accepted sign of evaporation increasing ionic concentrations in isolated seawater lagoons, whereas a general increase in marine calcium would be needed to present sufficient chemical stress that the whole of animal evolution would require a step-change for survival. It turns out that support for the hypothesis stems from two isotopic systems most usually associated with dating the formation and weathering of continental crust: those of strontium and neodymium. The global record of ratios of  $^{87}\text{Sr}/^{86}\text{Sr}$  and  $^{143}\text{Nd}/^{144}\text{Nd}$  show unusually large changes in the run-up to the Cambrian Period, the first rising to the highest level recorded in geological history and the second reaching a historic nadir during the Cambrian. This anti-correlation signifies the greatest chemical weathering of older continental crust in the [history of the Earth](#) (Peters, S. & Gaines, R.R. 2012. Formation of the 'Great Unconformity' as a trigger for the Cambrian explosion. *Nature*, v. **484**, p. 363-366). Not only would this have poured dissolved ions, including those of calcium, into the oceans and raised their concentrations in seawater, but vast areas of the continents would have been eroded to form huge coastal plains, ripe for marine inundation. The last is exactly what the near-universal unconformity at the base of the Cambrian signifies. Presaging this long drawn-out grinding of continents to their gums had been a protracted bout of continental assembly to form the [Rodinia](#) supercontinent around 1000 Ma through collision and mountain building. Then Rodinia broke apart, its fragments being driven by plate tectonics to reassemble, along with vast chains of new crust formed in volcanic island arcs, by yet more orogenesis: tectonically high-energy times matched by the processes of denudation on land.

A nice example of planetary interconnectedness on the largest scale with the greatest conceivable consequences, for we vertebrates anyhow. This comes as a great comfort to me in the twilight of my career, since in 1999 I stuck out my neck with a similar concept in *Stepping Stones* only to meet a suitably stony silence.

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## **Large-animal extinction in Australia linked to human hunters**

Posted on [April 13, 2012](#) by [Steve Drury](#) | [Leave a comment](#)





Artist's impression of a giant Australian wombat (Diprotodon) (credit: Wikipedia)

In North America, between 13 and 11.5 ka, around 30 species of large herbivorous mammals became extinct. Much the same occurred in Australia around 45 ka. Both cases roughly coincided with the entry of anatomically modern humans, where neither they nor earlier hominids had lived earlier. Such extinctions are not apparent in the Pleistocene records of Africa or Eurasia. An obvious implication is that initial human colonisation and a collapse of local megafaunas are somehow connected, perhaps even that highly efficient early hunting bands slaughtered and ate their way through both continents. But other possibilities can not be ruled out, including coincidences between colonisation and climate or ecosystem change. As many as thirteen different hypotheses await resolution, one that inevitably makes headline news repeatedly: that both the early Clovis culture and North American megafaunas met their end around the same time as the start of the Younger Dryas millennial cold snap because a meteorite exploded above North America (<http://earth-pages.co.uk/2009/03/01/comet-slew-large-mammals-of-the-americas/>). One problem in assessing the various ideas is accurately dating the actual extinctions, partly because terrestrial environments rarely undergo the continual sedimentation that builds up easily interpreted stratigraphic sequences. Another is that it is not easy to prove, say, that all giant kangaroos died in a short period of time because of the poor record of preservation of skeletons on land. A cautionary take concerns the demise of the woolly mammoth that roamed the frigid deserts of northern Eurasia and definitely was hunted by both modern humans and Neanderthals. It was eventually discovered that herds still survived on Wrangell Island until the second millennium BC. There is a need for a proxy that charts indirectly the fate of megafaunas plus accurate estimates of the timing of human colonisation. In North America there is a candidate for the first criterion: traces of a fungus (*Sporormiella* – see *Fungal clue to fate of North American megafauna* in *EPN* of January 2010) that exclusively lives in the dung of large herbivores. Fungal spores get everywhere, being wind-dispersed, and in NE US lake cores they fell abruptly at about 13.7 ka. *Sporormiella* needs to pass through the gut of herbivores to complete its life cycle.



Aboriginal Rock Art, Kakadu National Park, Australia (Photo credit: Wikipedia)

The same genus of fungus breaks down dung in Australia. Measuring spore content in sediment on the floor of a Queensland lake shows the same abrupt decline in abundance at between 43 to 39 ka before present (Rule, S. *et al.* 2012. The aftermath of a megafaunal extinction: ecosystem transformation in Pleistocene Australia. *Science*, v. **335**, p. 1483-1486). Moreover, the fungal collapse is accompanied by a marked increase in fine-grained charcoal – a sign of widespread fires – and is followed by a steady increase in pollen of scrub vegetation at the expense of that of tropical rain forest trees. The shifts do not correlate with any Southern Hemisphere climatic proxy for cooling and drying that might have caused ecosystem collapse. That still does not mark out newly arrived humans as the culprits, as the early archaeological record of Australia, as in North America, is sparse and only estimated to have started at around 45 ka. Yet this is quite strong circumstantial evidence. The 20 or more animals – marsupials, birds and reptiles – with a mass more than 40 kg that formerly inhabited the continent would probably have been ‘naive’ as regards

newly arrived, organised, well-armed and clever new predators, as would those of North America and much later in New Zealand, and would have been 'easy prey'. Incidentally, faunas of both Africa and Eurasia are extremely wary of humans, possibly as a result of a far longer period of encounters with human hunter-gatherers. In Australia's case, the use of deliberate fire clearing to improve visibility of game may have had a major role, although it is equally likely that the demise of large herbivores would have left large amounts of leaf litter and dry grasses to combust naturally. Yet the Earth as a whole around 40 ka was slowly cooling and drying towards the last glacial maximum around 20 ka, so human influence may merely have pushed the megafauna towards extinction, such is the fragility of Australia's ecosystems.

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## [A cuddly tyrannosaur](#)

Posted on [April 11, 2012](#) by [Steve Drury](#) | [Leave a comment](#)



Feathered dinosaur Deinonychus (Photo credit: Aaron Gustafson)

Feathered and fluffy [dinosaurs](#) in the families that may have led to birds have become almost commonplace, thanks to wonderful preservation in some Chinese Mesozoic sedimentary rocks (see <http://earth-pages.co.uk/2003/03/01/flying-feathers/>) and what has become a cottage industry for local people, under professional direction. Most have been small theropods in the [Coelurosauria](#) taxonomic branch that span the Jurassic and [Cretaceous](#) Periods. The famous Lower Cretaceous [Liaoning](#) lagerstätte in NE China recently yielded something truly awesome: three well-preserved specimens of a [feathered dinosaur](#) almost as large as the giant [tyrannosaurs](#) of the Late Cretaceous (i.e. > 1 tonne in life) (Xu, X. *et al.* 2012. A gigantic feathered dinosaur from the Lower Cretaceous of China. *Nature*, v. **484**. P. 92-95). In fact *Yutyrannus huali* ('beautiful feathered tyrant') is a member of the same subgroup as the Upper Cretaceous *T. rex* and was clearly a top predator in its day. Equally fortuitous is that the three specimens comprise one with a living body weight of about 1.4 t, the other two being between 500 and 600 kg. Various differences between the largest and the two smaller individuals suggest that the find represents two generations, the largest perhaps 8 years older than the two smaller ones. All three preserve densely packed filaments suggesting that they were fluffy rather than truly feathered. So why the difference from its probably scaly relative tyrannosaurs from about 50 Ma later? Around 125 Ma global climate was considerably cooler than the Late Cretaceous greenhouse world, Liaoning probably having mean annual air temperatures around 10°C compared with 18°C late in the Period. *Yutyrannus huali* and some of its contemporary theropods probably evolved high TOG insulation to ensure all-season sprightliness. It is also possible that a display function was also involved, as seems to have been the case for other dinosaurs.

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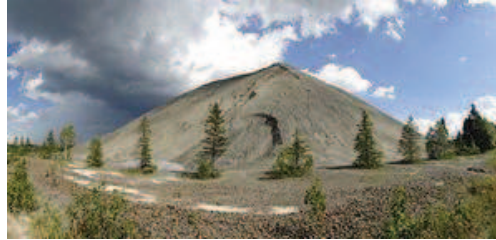
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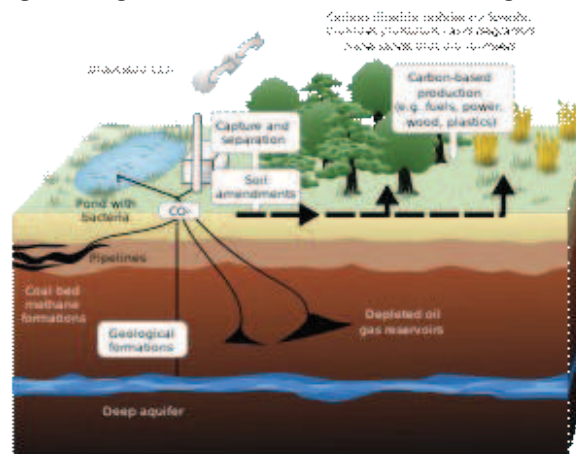
## **Possible snags and boons for CO<sub>2</sub> disposal**

Posted on [April 10, 2012](#) by [Steve Drury](#) | [Leave a comment](#)



Asbestos mine tailings at Thetford in Quebec, Canada. (Photo credit: Wikipedia)

Not many people would like to visit a waste heap at an asbestos mine. That is not because waste heaps are generally boring but all forms of asbestos are carcinogens when inhaled. Encountering pits in the tailings that emit puffs of warm air would cause health and safety alarm bells to ring. Yet that is exactly what has attracted researchers to the huge asbestos mining complex at Thetford in Quebec, Canada: the air leaving the vents can be extremely depleted in carbon dioxide (Pronost, J. and 10 others 2012. CO<sub>2</sub>-depleted warm air venting from chrysotile milling waste (Thetford Mines, Canada): Evidence for in-situ carbon capture and storage. *Geology*, v. **40**, p. 275-278). More precisely, the depletion – down to less than 10 parts per million (ppm) compared with normal atmospheric levels of 385 ppm – occurs in winter, when the puffing pits emit warm air far above the frigid air temperatures encountered in winter Quebec. The chrysotile must be reacting with groundwater and CO<sub>2</sub>, and is therefore a potential means of using near-surface natural materials for carbon capture and storage (CCS). The end product is an innocuous carbonate – Mg<sub>3</sub>(OH)<sub>2</sub>(CO<sub>3</sub>)<sub>4</sub>·4H<sub>2</sub>O – and dissolved silica. Quite a find, it might seem, as the reaction is exothermic too: CCS plus geothermal energy plus safe decomposition of a major environmental hazard. In fact any magnesium-rich silicates are likely to undergo the same carbonation reaction, especially if ground-up to increase the net surface area exposed to moist air.



scheme for carbon sequestration and storage at a coal-fired power plant. Rendering by LeJean Hardin and Jamie Payne. Source: [http://www.ornl.gov/info/ornlreview/v33\\_2\\_00/research.htm](http://www.ornl.gov/info/ornlreview/v33_2_00/research.htm)

The parent asbestos rock at Thetford is a metamorphic derivative from mantle ultramafic rocks in an ophiolite, and the asbestos insulation business, both for extremely hazardous blue (crocidolite) and less dangerous white (chrysotile) asbestos has been hugely profitable since the 19<sup>th</sup> century. Consequently, wherever there are altered ophiolites, generally in collision-zone orogenic belts, asbestos has been exposed either naturally or through mining and processing. There are many related cancer ‘hot spots’ in populous

mining areas of Canada, India, the Alps and southern Africa, and in dry climates even natural exposures pose considerable risk. Could these blighted areas take on a new role in lessening the chance of global warming? About 30 billion tonnes of CO<sub>2</sub> are emitted by burning fossil fuels each year. To keep pace, at the current atmospheric concentration of CO<sub>2</sub>, some 75 trillion tonnes of air would have to react annually with about 100 billion tonnes of magnesian silicate, making this form of CCS the largest industry on the planet (<http://www.newscientist.com/article/mg21428593.800-stripping-co2-from-air-requires-largest-industry-ever.html>). Another factor tempering somewhat forced optimism for CCS as a way of having our fossil fuel cake and eating it is that direct injection of greenhouse gases into deep storage may have an unforeseen down-side. Deep drilling and injection of fluids may trigger earthquakes. The alarm raised by small yet disturbing seismicity accompanying sites for shale-gas development by ‘fracking’ (<http://earth-pages.co.uk/2011/11/04/fracking-check-list/> and <http://earth-pages.co.uk/2011/10/14/britain-to-be-comprehensively-fracked/>) has died down to some extent following detailed analysis of small earthquakes around drilling sites. It turns out that they are triggered not by the drilling itself but the subsurface disposal of the large amounts of fluids that have to be passed through the oil shales to make the tight rock permeable to gas (Kerr, R.A. 2012 Learning how to NOT make earthquakes. *Science*, v. 23p. 1436-1437). Safe subsurface disposal requires injection wells penetrating 1 to 3 km below the surface, often below the cover of sedimentary strata and into crystalline basement. Such hard rocks store elastic strain induced by burial and tectonics, and release it when lubricated by fluids, especially if they contain dormant faults. Once impermeable rock can thus be hydrofractured in the same manner as ‘fracked’ gas-prone shales and old, often unsuspected faults reactivate: a catastrophic prospect for injected CO<sub>2</sub>. In sedimentary sequences, drilling CCS wells into porous rocks capped by impermeable ones – the scenario for ‘safe’ gas storage – could also induce ‘fracking’ of the sealing rocks and thereby causing leakage (see also <http://www.newscientist.com/article/dn21633-fracking-could-foil-carbon-capture-plans.html>).

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