



INFORME GEOBRASIL

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◆ DICAS DA SEMANA

DICAS PARA APROVEITAR O PRÓXIMO CONGRESSO INTERNACIONAL DE GEOLOGIA A FLORENÇA

A partir de setembro a novidade do site: dicas sobre sítios geológicos imperdíveis na Itália, as cidades merecedoras de serem conhecidas pertinho de Florença e para quem dispuser de mais tempo para fazer um giro na península, o que saborear, compras, etc... O mês de setembro é ideal para viajar na Itália: as férias de verão terminaram, os turistas se foram, é baixa estação e os preços voltam ao normal e em geral faz um calor agradável. A combinação perfeita para justificar umas férias prolongadas e conhecer o país.

VISITE O PORTAL DE ÁGUAS SUBTERRÂNEAS WWW.PERFURADORES.COM.BR

O site perfuradores.com é o primeiro a atuar no ramo do conhecimento da exploração da água subterrânea. A empresa se propõe a difundir e integrar os seguimentos desta área, desde a Universidade ao consumidor final da mesma, passando por empresas especializadas na exploração, fornecedores de produtos, pesquisadores, e toda a comunidade. O grande diferencial da perfuradores.com, é disponibilizar viabilizando em um mesmo site todas as informações científicas sobre o tema, dicas importantes para a preservação da água subterrânea, assim como, interligar as empresas que atuam no ramo com o seu cliente e vice-versa.
Equipe Perfuradores.com

INSCRIÇÃO EM CONCURSO DE FOTOGRAFIA VAI ATÉ O DIA 20

O concurso "Um Olhar sobre o Meio Ambiente Urbano - Alternativas para as Cidades", que oferece R\$ 11 mil em prêmios, foi criado para revelar e expor formas criativas e inusitadas de interação entre o ser humano e o meio ambiente nas cidades brasileiras.

ALERTA DE VÍRUS

O vírus Blaster, na verdade um worm também conhecido como MSBlast ou LovSan, atacou desde segunda-feira mais de 188 mil computadores ao redor do mundo e está retardando o tráfego da internet, segundo reportagem da BBC. Ele afeta o compartilhamento de arquivos realizado através de redes e, depois de contaminar o computador, procura por outros que ainda estejam vulneráveis. De acordo com o site Ananova.com, os computadores infectados estão programados para atacar automaticamente o site windowsupdate.com, da Microsoft, no próximo sábado.

Worms são programas que fazem cópias de si próprios automaticamente e se redistribuem, geralmente por e-mail. Eles são comumente chamados de vírus, mas não têm o poder de destruir dados. Seus ataques exploram vulnerabilidades dos programas - geralmente ligados à internet - e se reproduzem com tal velocidade que acabam entupindo as vias de tráfego de dados.

O Blaster é incomum porque não se espalha especificamente via e-mail, mas pode viajar através de uma conexão normal de internet. O vírus carrega uma mensagem para o dono da Microsoft, informou a Reuters: "Bill Gates, porque você deixa isso acontecer? Pare de fazer dinheiro e conserte seu software!". Outra mensagem encontrada vem com a frase: "I just want to say LOVE YOU SAN!"

De acordo com as estatísticas da empresa de segurança Symantec, grande parte dos computadores atingidos está nos Estados Unidos e na Grã-Bretanha. Mas já foram reportados problemas até na China, segundo a BBC. Entre as vítimas estão o Federal Reserve Bank de Atlanta, os escritórios governamentais em Hong Kong e a fábrica de carros alemã BMW.

Outro fato preocupante é o crescimento da velocidade de propagação do Blaster. Em um teste realizado pela empresa de segurança F-Secure, um computador sem proteção foi conectado à internet para que fosse calculado o tempo que levaria para ser infectado. Na madrugada desta terça-feira, demorou 5 minutos e 30 segundos mas, horas depois, a mesma máquina foi encontrada e infectada em apenas 27 segundos.

Algumas das medidas indicadas para evitar problemas com o worm são manter o antivírus atualizado, aplicar programas que eliminem as vulnerabilidades do Windows, aplicar programas de limpeza para eliminar o vírus das máquinas infectadas e usar firewall nas conexões em banda larga. A BBC informa que os sistemas afetados são: Windows NT 4.0, Windows NT 4.0 Terminal Services Edition, Windows 2000, Windows XP e Windows Server 2003.

Matéria retirada de Globo.com

◆ CONCURSOS

ANÚNCIO DE VAGAS PARA GEÓLOGOS E ENGENHEIRO DE MINAS

Empresa: CVRD - Cia. Vale do Rio Doce
Local: Santa Luzia/Minas Gerais
Cargo: Geólogo Júnior
Graduação: Geologia
Curso de Especialização em mineralogia aplicada ao beneficiamento
Habilidades:
- 2 a 3 anos de experiência em caracterização mineralógica de minérios - Inglês Fluente

Cargo: Geólogo Master
Graduação: Geologia
Curso de Especialização em Geofísica
Habilidades:
- 10 anos de experiência profissional
- Profundo conhecimento em métodos geofísicos de exploração mineral; - Larga experiência em fiscalização e interpretação de resultados dos diversos métodos e seu significado geológico; - Inglês Fluente.

Cargo: Geólogo Master
Graduação: Geologia/ Eng^a de Minas
Curso de Especialização em Geoestatística
Habilidades: - 5 anos de experiência
- Desejável sólidos conhecimentos de softwares especialistas de Geoestatística (GSLIB, ISATIS) - Conhecimento de Autocad - Sólidos conhecimentos de Excel. Word, Power Point - Inglês Avançado

Cargo: Geólogo Master
Graduação: Geologia/ Eng^a de Minas
Curso de Especialização e avaliação de depósitos primários de diamantes
Habilidades:
- 10 anos de experiência em prospecção de fontes primárias de diamante, operação de planta de meio denso, interpretação da química de minerais, avaliação de teores utilizando microdiamantes, gerenciamento de projetos e integração de dados. - Inglês Fluente

Cargo: Geólogo Master
Graduação: Geologia
Desejável curso de Especialização em GIS e Banco de Dados
Habilidades:
- Profundo conhecimento e experiência em geotecnologia GIS e suas aplicações, administração de sistemas e rede, conhecimento das ferramentas de tecnologia de informação - Inglês Fluente

Interessados deverão encaminhar currículo URGENTE para o e-mail:
recrutamento@quatre.com.br
Daniela Ferreira
Consultora em RH
Quatre - Consultores em Recursos Humanos Tel: (31) 3484-4746

CONCURSO PÚBLICO PARA PROFESSOR ASSISTENTE - UERJ

Instituto de Geociências - UERJ torna público o Edital de Abertura de inscrições, normas e programas, nos termos da Resolução 03/UERJ/91 e Ato Executivo 45/UERJ/93.
1 vaga para Oceanografia e Hidrologia Oceanografia Biológica com ênfase em Ecotoxicologia de Mamíferos Marinhos
Maiores Informações: <http://www2.uerj.br/~srhconcurso/>

◆ LIVROS

LISTA DE LIVROS DO SITE WWW.EARTH-PAGES.COM

É disponível no site uma vasta lista de livros relacionados a geociências (veja também no ítem "Livros" do nosso site).

◆ CURSOS E PALESTRAS

O Instituto de Estudos Avançados da USP tem o prazer de convidar para a Conferência do Mês de Agosto de 2003 - Mudanças Climáticas e Mitigação pela Agricultura - a ser proferida pelo Prof. Dr. Carlos

Clemente Cerri do Centro de Energia Nuclear na Agricultura da USP, no próximo dia 28 de agosto, às 16h00, na sede do IEA/USP (Av. Prof. Luciano Gualberto, Trav. J, 374 - térreo, sala 15, Cidade Universitária, São Paulo).

Pedimos a gentileza de confirmar sua presença com Claudia Regina pelo mail claregi@usp.br ou fones (011) 3091-3919 e 3091-4440.

◆ ÍNDICE DE NOTÍCIAS

• AMBIENTE BRASIL

ACIDENTE PÁRA USINA NUCLEAR ANGRA I

O aumento da taxa de passagem do sistema primário para o secundário provocou o desligamento da Usina Angra I na quarta-feira (7). A parada do sistema, para reabastecimento e inspeção dos tubos de geradores de vapor, estava prevista para o dia 27 de setembro, mas, foi antecipada devido a este "evento não usual".

II CURSO SOBRE RECOMPOSIÇÃO DE ÁREAS DEGRADADAS EM NITERÓI/RJ

O curso é dividido em módulos, como "Ecosistemas Manguezais", que descreve este tipo de ecossistema e "Manguezais de Niterói", que aborda a estruturação de um projeto ambiental, seu desenvolvimento e objetivos.

VEGA DO SUL É AUTUADA POR VAZAMENTO DE CROMO EM SC

A solução de cromo hexavalente que vazou é altamente perigosa e, segundo avaliação técnica, o setor de cromatização estava despreparado, sendo ainda relatada a ausência e desconhecimento dos procedimentos emergenciais em caso de acidentes.

ALERJ VOTA EMENDA QUE REDUZ REPASSE DE ROYALTIES DO PETRÓLEO À ÁREA AMBIENTAL

A Assembléia Legislativa do Rio vota nesta terça-feira a emenda constitucional encaminhada pela governadora Rosinha Matheus, reduzindo de 20% para 5% o repasse da arrecadação dos royalties do petróleo destinados ao Fundo Estadual de Controle Ambiental.

PROGRAMA DE DESPOLUIÇÃO DA BAÍA DE GUANABARA/RJ CONCLUI PRIMEIRA ETAPA EM DOIS ANOS

O vice-governador do Rio de Janeiro, Luiz Paulo Conde, garantiu que a primeira etapa do Programa estará concluída dentro de dois anos, beneficiando cinco milhões de pessoas com obras de saneamento e esgotamento sanitário.

PROJETO DE PRESERVAÇÃO DO AQUÍFERO GUARANI SERÁ LANÇADO EM SETEMBRO

Acontecerá em Ribeirão Preto (SP), entre os dias 17 e 19 de setembro, o lançamento do Projeto de Proteção Ambiental e Desenvolvimento Sustentável do Aquífero Guarani no Brasil. O evento terá workshop de modelos e oficinas de trabalho e será realizado na faculdade COC. Em breve será disponibilizada a programação. Maiores informações com Ana Luiza Sabóia de Freitas, da coordenação nacional: (61) 445-5332; anafreitas@ana.gov.br. (ICV)

O GARIMPO E O MERCÚRIO VOLTAM À AMAZÔNIA

A ONG Amigos da Terra - Amazônia Brasileira garante que já existem evidências da retomada do garimpo em nove pólos e alerta: os poderes públicos estariam despreparados para encarar os impactos ambientais e sociais do retorno dessa atividade econômica.

UNIMA/RJ OFERECE CURSO MBA EM PERÍCIA AMBIENTAL

A duração é de 18 meses e as aulas serão aos sábados, o dia inteiro. São 450 horas, com apresentação de monografia ao final. Segundo o diretor-executivo da Unima, Paulo Braga, o objetivo é qualificar profissionais para identificação dos impactos que sofre o meio ambiente.

• JORNAL DA CIÊNCIA

CAPES RECEBE INSCRIÇÕES PARA BOLSAS DE DOUTORADO NO EXTERIOR

A Capes está com inscrições abertas até 1º de setembro para bolsas de doutorado no exterior

Os candidatos devem ter comprovado desempenho acadêmico e dirigirem-se a instituições de excelência e prestígio internacional.

As inscrições são recebidas exclusivamente no site da Capes, onde também podem ser obtidas orientações para candidaturas - <http://www.capes.gov.br>

Até o final de agosto, a Capes divulga os ganhadores das bolsas com início previsto para este semestre, que foram selecionados em processo iniciado ainda em 2002.

VAZAMENTO EM GERADOR DE ANGRA 1 PROVOCA POLÊMICA

Estatal quer retomar operação em 60 dias, mas prefeito anuncia recurso à Justiça
Felipe Werneck escreve para 'O Estado de SP':

Apesar da ameaça do prefeito de Angra dos Reis, Fernando Jordão (PSB), de tentar impedir na Justiça o funcionamento da Usina Angra 1, a Eletronuclear, que administra a unidade, informou nesta segunda-feira que ela deverá voltar a operar em 60 dias.

Na quarta-feira, foi detectado um problema no gerador de vapor e técnicos decidiram interromper o funcionamento da usina como medida de segurança, de acordo com a estatal.

Ainda segundo a empresa, um aumento anormal de pressão no gerador de vapor provocou vazamento de água do sistema primário de refrigeração do reator nuclear.

O incidente provocou a antecipação da operação de desligamento da usina para reabastecimento e manutenção, previsto para 27 de setembro. A Eletronuclear admitiu que os geradores de vapor da usina devem ser trocados e alegou já ter dado início ao processo de licitação, com a publicação do edital.

Segundo a Comissão Nacional de Energia Nuclear (Cnen), as causas do problema e a extensão dos danos serão investigadas após a inspeção do reator. O órgão garantiu, porém, que 'não houve liberação de radiação para o ambiente'.

Dúvida - O prefeito de Angra afirmou que recorrerá nesta terça-feira ao Judiciário para tentar impedir o funcionamento de Angra 1.

'Vou entrar na Justiça para que a usina continue desligada até a troca dos geradores de vapor. Na dúvida, prefiro ser cauteloso, porque a população não pode correr risco', disse Jordão. 'Sou um defensor da construção de Angra 3, mas não posso ficar à mercê da Eletronuclear. A responsabilidade sobre o município é minha.'

O presidente da Eletronuclear, Zieli Dutra Thomé Filho, disse nesta segunda-feira que a operação de Angra 1 deverá ser retomada em 60 dias.

'Não queremos camuflar nada. Não há justificativa para o fechamento da usina. Não há motivo para não estarmos tranquilos', afirmou.

O Estado de SP, 12/8

PACÍFICO PERDE CAPACIDADE DE ABSORVER CO2

Região norte do oceano teve a salinidade aumentada pela falta de chuvas, diminuindo fixação de gás do efeito estufa

Reinaldo José Lopes escreve para a 'Folha de SP':

Um dos mais importantes mecanismos do planeta para absorver CO₂, o principal gás responsável pelo aquecimento global, pode estar com defeito.

Oceanógrafos americanos verificaram que o Pacífico está diminuindo sua capacidade de retirar o gás da atmosfera - mais uma má notícia para o já combalido clima da Terra.

'Nosso estudo não diz nada sobre aquecimento - de fato, não houve mudança significativa na temperatura da superfície do oceano nos 13 anos de dados que nós analisamos', afirma o oceanógrafo John Dore, 37, da Universidade do Havaí.

Entretanto, mesmo sem reviravoltas perceptíveis na temperatura, Dore e seus colegas Roger Lukas, Daniel Sadler e David Karl perceberam que uma seca persistente no Pacífico Norte aumentou a concentração de sal do oceano e, conseqüentemente, sua capacidade de retirar o indesejável dióxido de carbono da atmosfera.

'O oceano funciona como um sorvedouro de carbono sempre que a pressão do CO₂ nas águas superficiais é menor que a pressão do CO₂ no ar acima delas', explica Dore.

Na prática, isso significa que o gás tende a passar dos lugares onde sua concentração é maior para as áreas onde ele existe em menor concentração.

Quando uma área do oceano está borbulhando de fitoplâncton (microrganismos marinhos que fazem o papel das plantas, transformando gás carbônico e luz em biomassa), por exemplo, a tendência é que o CO₂ na água diminua e o que existe na atmosfera passe para o mar.

Por outro lado, quando as águas mais frias e cheias de material orgânico do fundo do oceano são aquecidas e chegam à superfície, cresce a concentração do gás, e ele volta para a atmosfera.

'A região central do Pacífico Norte, onde nós conduzimos o nosso estudo, é um sumidouro de carbono, embora não muito forte. Mesmo assim, ela é importante por causa de sua grande área', afirma Dore, cujo estudo está na revista 'Nature' (<http://www.nature.com>)

Situação salgada

Há, contudo, outro fator envolvido: o grau de salinidade do mar. A seca que os pesquisadores havaianos observaram em 13 anos de dados da estação meteorológica Aloha, cujo pico se deu entre 1996 e 2000, causou uma evaporação exagerada da água oceânica.

Ou seja: comparativamente, havia menos água e mais sal ou outras substâncias dissolvidas nela -incluindo o CO₂, que passou a escapar para a atmosfera em vez de afundar no oceano.

O difícil é saber quão abrangente é o fenômeno. Dore diz que a seca observada pelo grupo havaiano cobriu boa parte das latitudes médias do Pacífico Norte e pode estar ligada a uma seca ainda maior que atingiu a América do Norte e a Europa, mas a conexão entre os dois eventos ainda precisa ser confirmada.

Seja como for, o oceanógrafo afirma que é preciso começar a prestar atenção no fenômeno: 'Até onde nós sabemos, ninguém tinha reconhecido que esse mecanismo poderia ser importante no ciclo do carbono. A química por trás dele está bem estabelecida, mas, sem de dados de longo prazo, nenhuma evidência dos efeitos das mudanças de salinidade teria aparecido'.

Se o fenômeno for persistente (e Dore diz que apenas vários anos de muita chuva poderiam revertê-lo), regiões marinhas que hoje engolem dióxido de carbono podem se transformar em fontes dele. Mais CO₂ na atmosfera significa mais retenção de energia solar na Terra -e, portanto, um aquecimento global mais acentuado.

Dore, contudo, pede cautela. 'É só observando pacientemente áreas específicas do oceano por longos períodos que poderemos entender essa variabilidade.'

Folha de SP, 14/8

ESTUDO DE BACTÉRIAS PODE DAR PISTAS PARA ENTENDER O AQUECIMENTO GLOBAL

Fitoplâncton, organismos unicelulares com apenas 2 mil genes, transformam luz solar em alimento

Organismos unicelulares marinhos - o fitoplâncton - têm genomas compactos e eficientes que permitem que funcionem como painéis solares flutuantes.

A comparação de quatro espécies diferentes de fitoplâncton mostrou como fazem seu trabalho - de conversão da energia solar em alimento - com pouquíssimos genes.

Compreender como eles fazem isso pode nos ajudar a, um dia, aproveitar melhor a energia solar e a minimizar os efeitos do aquecimento global.

'Compete a nós compreender exatamente como, com apenas 2 mil genes, esses organismos convertem a energia solar em elementos essenciais à vida', afirma Sallie Chisholm, do Massachusetts Institute of Technology (MIT), uma das principais pesquisadoras dos estudos publicados ontem nas revistas Nature e Proceedings of the National Academy.

Equipes de cientistas dos EUA, França e Israel analisaram três espécies de Prochlorococcus e uma de Synechococcus.

'Esses organismos são muito mais do que criaturas exóticas, eles dominam os oceanos. Há cerca de 100 milhões de Prochlorococcus por litro de água marinha, por exemplo', explica Sallie. O fitoplâncton é a base da cadeia alimentar, fornecendo alimento para uma grande variedade de animais.

Carbono

Ele também fixa dois terços do carbono no oceano - o que significa que absorve o carbono da atmosfera para realizar a fotossíntese e libera oxigênio. Isso mostra sua importância no aquecimento global, causado em parte pela liberação de dióxido de carbono.

'Toda vida na Terra depende igualmente da fotossíntese que tem lugar nos oceanos', escreveu Donald Bryant, do Depto. de Bioquímica e Biologia Molecular da Pennsylvania State University, no comentário que acompanha os estudos.

Mas o fitoplâncton é minúsculo.

'Se enfileirarmos cem dessas células teremos o equivalente à largura de um fio de cabelo, mas elas são tão abundantes que respondem, às vezes, por 50% da biomassa fotossintética dos oceanos', afirma Gabrielle Rocop, professora assistente de Oceanografia da Universidade de Washington.

Os cientistas estão descobrindo que a comparação genética de diferentes espécies pode dar boas pistas sobre como esses microrganismos fazem seu trabalho. 'Mas ainda não sabemos a função de metade desses genes', afirma Sallie. (Reuters)

O Estado de SP, 14/8

• INFOMET

* MINERACAO & NAO-FERROSOS *

ANGLOGOLD COMPRA A ASHANTI POR 1,089 BILHAO DE DOLARES

GLAMIS REVE PARA BAIXO META DE SAN MARTIN
REATIVACAO DE REFUGIO SERA ´ DECIDIDA EM SETEMBRO
YANACOCOA PAGA DIVIDENDOS
EMPRESAS DA CHINA UNEM-SE PARA COMPETIR COM ESTATAL DE ALUMINIO
LUCRO DA MINERADORA ANGLO AMERICAN SURPREENDE NO 1O SEMESTRE
TERMINA GREVE EM ESCONDIDA
RANDGOLD NA BRIGA PELA ASHANTI
CODELCO PLANEJA EMISSAO
VALE DO RIO DOCE CONQUISTA MERCADO DE MINERIO DE FERRO; VENDA CRESCE 28%
APEX FARA ´ ESTUDO PARA DEFINIR ACOES
LUCRO MENOR NA ANGLO
COBRE PERUANO
VALE PODE PARTICIPAR DE PROJETO DE COBRE NO PERU
VALE DEVE APRESENTAR RESULTADO DE R\$ 1,4 BILHAO
ACAO DA VALE VOLTA A SUBIR E RENDE 16% EM UM MES

- **PORTAL DO GEÓLOGO**

O TRISTE FIM DA CBC
VALE MOSTRA OS RESULTADOS DO PRIMEIRO TRIMESTRE DE 2003
A DURA VIDA DE UM MINERADOR NA RÚSSIA
PETRÓLEO CAMINHA PARA A AUTO-SUFICIÊNCIA
CHINA 2003, O IMPÉRIO CONTRA-ATACA!
BRASIL MINERAÇÃO, O BRASIL QUE POUCOS CONHECEM
STAR RESOURCES PROSSEGUE NA AQUISIÇÃO DO GARIMPO TOCANTINZINHO NO TAPAJÓS
PETROBRÁS DEVERÁ DEVOLVER 22 ÁREAS DE EXPLORAÇÃO
MEDIDA PROVISÓRIA SOBRE DIAMANTES BRUTOS
GAÚCHOS MAPEIAM 1.200 KM DO FUNDO DO MAR BRASILEIRO
ENQUANTO O BRASIL DEMONSTRA COMPETÊNCIA NA AGRICULTURA A MINERAÇÃO CONTINUA POR BAIXO.
INFRAESTRUTURA NO FUNDO DO POÇO
PORQUE O CANADA ATRAI MAIS DINHEIRO PARA EXPLORAÇÃO QUE OS OUTROS?
ARGYLE, A ÚNICA MINA DE DIAMANTE DA AUSTRALIA
A ÁGUA NA TERRA ESTÁ SE ESGOTANDO- É VERDADE QUE NO FUTURO PRÓXIMO TEREMOS UMA GUERRA PELA ÁGUA?
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BELGO MINEIRA ANUNCIA RECORDE DE EXPORTAÇÃO
MERCADO RUSSO DE DIAMANTES EM POLVOROSA
DYNATEC TERÁ 53% SE INVESTIR US\$20M
BILLITON INVESTE US\$4M EM PROJETO DE CU-NI-PGM
WMC SE RECUPERA E DÁ LUCRO DE A\$47M NO PRIMEIRO SEMESTRE DE 2003.
RECURSOS DO PUMA-ONÇA JA PASSAM DE 100M DE TONELADAS

- **MUNDOGEO**

GITAINTERNACIONALINTEGRAMERCADOMUNDIALDEGEOINFORMAÇÃO
SPACEIMAGINGENTREGAIMAGENSDESATÉLITEAOGVERNODESÃO PAULO
GEODESIGNASSINACONTRATOCOMAMAPPINGSCIENCE
SENSORIAMENTOREMOTODOINPEACOMPANHAMOBILIZAÇÃO DOSSEM-TERRA
UERJTERÁ LABORATÓRIO DE MAPEAMENTO COM CURSOS DE GEOPROCESSAMENTO
CENTRO DE PESQUISA MAPEIA PARASITADA ESQUISTOSSOMO SE EMPERNAMBUCO
SATÉLITE ENVISAT CAPTA REDUÇÃO DO MAR DE ARAU
ISRAELENSES BUSCAM PARCERIA NO INPE ENA AEB
IBGEEEMBRAPADISPONIBILIZAM MAPA DE SOLOS DO BRASIL

- **SCIENCE**

CORAL REEFS UNDER SIEGE

Coral reefs across the globe are widely perceived to be undergoing serious degradation brought about by warmer climate conditions, and three reports document these declines (see also the Review by Hughes et al., p. 929). Much of the data to support this contention are from fragmented small-scale studies of

individual reefs or are of an anecdotal nature. Gardner et al. (p. 958) performed a meta-analysis of the decline of coral reefs on a broad geographic scale. They analyzed within-site changes in coral cover across the Caribbean based on data from 263 sites for a period of 25 years and found a dramatic decline in coral cover (from ~50 to 10%) during this period. These declines are consistent across the Caribbean region, with variation in the timing of onset of the declines providing clues as to the likely causes. Pandolfi et al. (p. 955) used an exhaustive historical data set to document the global decline of coral reefs during the past several thousand years. Trajectories of ecosystem decline were strikingly similar among regions that were all substantially degraded before the 20th century. Such historical analyses can allow management programs to anticipate probable losses of species and habitats at individual locations through an understanding of the characteristic pattern of ecosystem decline. A particularly striking example of the widespread, rapid death of coral reefs, and how it may be connected to global warming, is presented by Abram et al. (p. 952), who found that the escalating phenomenon of tropical wildfire represents a new threat. By using coral growth, paleothermometry, and trace element signals, they attribute an episode of catastrophic reef death in Indonesia in 1997 to a giant algal bloom (red tide), which they argue was caused by atmospheric fallout of nutrients from the 1997 Indonesian wildfires. Although they note that the wildfire event was highly unusual, the climatic conditions at the time were not exceptional.

SPRINGBOARD FOR PREBIOTIC SYNTHESIS

One of several models for the origin of life is that the building organic chemicals were synthesized and concentrated by mineral catalysts in hot springs. Indeed, previous work has shown that under reducing conditions, iron-nickel sulfides can polymerize CO into amino acids, peptides, and other complexes. Huber et al. (p. 938) now show that these sulfide minerals can drive a peptide cycle--a precondition for a metabolic cycle. Peptides are both formed from amino acids and degraded to urea under the same conditions, and the energy for both reactions comes from the oxidation of CO to CO₂.

HEMISPHERIC CLIMATE CONNECTIONS

The relative scarcity of high temporal resolution marine records of climate change from the Southern Hemisphere has hampered efforts to determine the relative timing of climate-related changes in the oceans of the Southern Hemisphere and in the Arctic and the Antarctic. Pahnke et al. (p. 948) present a series of paleoceanographic records from the subantarctic Southwest Pacific Ocean that show abrupt swings of high amplitudes. They document that such intense and abrupt climate changes were a persistent Southern Hemisphere feature during the past 340,000 years. Thus, climate in some parts of the Southern Hemisphere oscillated at far larger amplitudes than is documented in ice cores from Vostok, Antarctica. The authors suggest that these rapid swings changed from occurring in-phase with Northern Hemisphere variability to occurring in-phase with high-latitude Southern Hemisphere variations.

A FRESH LOOK

Hanson

Most of the Amazon rain forest, even in western Peru and Brazil, is not far above sea level, and it has been proposed that during the Miocene (about 10 to 20 million years ago), much of this region was part of a shallow inland sea or seaway connected to the Atlantic or Caribbean. This notion is controversial, however, and resolving the geography has implications for the extent and development of rainforest flora and fauna during this and later periods. Vonhof et al. used carbon, oxygen, and strontium isotope measurements of mollusks in the dominant Pebas Formation to analyze the composition of the waters across western Amazonia during this time. Together, these isotopes reflect and fingerprint the origins and salinity of waters. The results show that most of this formation represents deposition in a shallow freshwater lake and swamp, where most of the water was derived from snowmelt in the Andes and was sufficient to prevent any marine incursion and large enough to have tides. In one period, about 11 million years ago, outcrops to the northeast show evidence of brackish water, implying a limited marine incursion, perhaps from a connection to the Caribbean, that was insufficient to produce a marine seaway. *Geol. Soc. Am. Bull.* 115, 983 (2003)

OUTRAS NOTICIAS

The Crucial 80% of Life's Epic

Guy M. Narbonne

<http://www.sciencemag.org/cgi/content/summary/301/5635/919?etoc>

p. 919

Enhanced: Superlakes, Megafloods, and Abrupt Climate Change

Garry Clarke, David Leverington, James Teller, and Arthur Dyke

<http://www.sciencemag.org/cgi/content/summary/301/5635/922?etoc>

Vesuvius' One-Two Punch

Science 2003 August 15; 301(5635): p. 915a

<http://www.sciencemag.org/cgi/content/summary/301/5635/915a?ct>

Ice Core Records of Atmospheric N₂O Covering the Last 106,000 Years

Todd Sowers, Richard B. Alley, and Jennifer Jubenville

<http://www.sciencemag.org/cgi/content/abstract/301/5635/945?etoc>

p. 945

340,000-Year Centennial-Scale Marine Record of Southern Hemisphere Climatic Oscillation

Katharina Pahnke, Rainer Zahn, Henry Elderfield, and Michael Schulz

<http://www.sciencemag.org/cgi/content/abstract/301/5635/948?etoc>

p. 948

• NATURE

CLIMATE-DRIVEN CHANGES TO THE ATMOSPHERIC CO₂ SINK IN THE SUBTROPICAL NORTH PACIFIC OCEAN

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The oceans represent a significant sink for atmospheric carbon dioxide. Variability in the strength of this sink occurs on interannual timescales, as a result of regional and basin-scale changes in the physical and biological parameters that control the flux of this greenhouse gas into and out of the surface mixed layer. Here we analyse a 13-year time series of oceanic carbon dioxide measurements from station ALOHA in the subtropical North Pacific Ocean near Hawaii, and find a significant decrease in the strength of the carbon dioxide sink over the period 1989–2001. We show that much of this reduction in sink strength can be attributed to an increase in the partial pressure of surface ocean carbon dioxide caused by excess evaporation and the accompanying concentration of solutes in the water mass. Our results suggest that carbon dioxide uptake by ocean waters can be strongly influenced by changes in regional precipitation and evaporation patterns brought on by climate variability.

Nature 424, 754 - 757 (14 August 2003); doi:10.1038/nature01885

STABILIZING FEEDBACKS IN GLACIER-BED EROSION

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Glaciers often erode, transport and deposit sediment much more rapidly than nonglacial environments, with implications for the evolution of glaciated mountain belts and their associated sedimentary basins. But modelling such glacial processes is difficult, partly because stabilizing feedbacks similar to those operating in rivers have not been identified for glacial landscapes. Here we combine new and existing data of glacier morphology and the processes governing glacier evolution from diverse settings to reveal such stabilizing feedbacks. We find that the long profiles of beds of highly erosive glaciers tend towards steady-state angles opposed to and slightly more than 50 per cent steeper than the overlying ice–air surface slopes, and that additional subglacial deepening must be enabled by non-glacial processes. Climatic or glaciological perturbations of the ice–air surface slope can have large transient effects on glaciofluvial sediment flux and apparent glacial erosion rate.

Nature 424, 758 - 760 (14 August 2003); doi:10.1038/nature01839

INTENSE EQUATORIAL FLUX SPOTS ON THE SURFACE OF THE EARTH'S CORE

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A large number of high-accuracy vector measurements of the Earth's magnetic field have recently become available from the satellite Oersted, complementing previous vector data from the satellite Magsat, which operated in 1979/80. These data can be used to infer the morphology of the magnetic field at the surface of the fluid core, 2,900 km below the Earth's surface. Here I apply a new methodology to these data to calculate maps of the magnetic field at the core surface which show intense flux spots in equatorial regions. The intensity of these features is unusually large—some have intensities comparable to high-latitude flux patches near the poles, previously identified as the major component of the dynamo field. The tendency for pairing of some of these spots to the north and south of the geographical equator suggests they might be associated with the tops of equatorially symmetric columnar structures in the fluid, or their antisymmetric equivalents. The drift of the equatorial features may represent material flow or could represent wave motion; discrimination of these two effects based on future data could provide new information on the strength of the hidden toroidal magnetic field of the Earth.

Nature 424, 760 - 763 (14 August 2003); doi:10.1038/nature01879

CLIMATE CHANGE DECREASES AQUATIC ECOSYSTEM PRODUCTIVITY OF LAKE TANGANYIKA, AFRICA

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Although the effects of climate warming on the chemical and physical properties of lakes have been documented, biotic and ecosystem-scale responses to climate change have been only estimated or predicted by manipulations and models. Here we present evidence that climate warming is diminishing productivity in Lake Tanganyika, East Africa. This lake has historically supported a highly productive pelagic fishery that currently provides 25–40% of the animal protein supply for the populations of the surrounding countries. In parallel with regional warming patterns since the beginning of the twentieth century, a rise in surface-water temperature has increased the stability of the water column. A regional decrease in wind velocity has contributed to reduced mixing, decreasing deep-water nutrient upwelling and entrainment into surface waters. Carbon isotope records in sediment cores suggest that primary productivity may have decreased by about 20%, implying a roughly 30% decrease in fish yields. Our study provides evidence that the impact of regional effects of global climate change on aquatic ecosystem functions and services can be larger than that of local anthropogenic activity or overfishing.

Nature 424, 766 - 768 (14 August 2003); doi:10.1038/nature01833

• EARTH PAGES

WEB RESOURCES

Smithsonian Dynamic Earth site

The Smithsonian Institute's National Museum of Natural History has a new and evolving Earth science website at www.mnh.si.edu/earth (Flash 6 and printable versions). Currently only the Rocks and Mining section is up and running, but it is instructive at the introductory level. To come are sections on gemstones, plate tectonics and the Solar System. There are also downloads and a geogallery. It is somewhat slow in Flash using a normal dial-up connection., but the printable version has no images. With a fast connection, this is likely to become a favourite for elementary visualisation of Earth processes.

CLIMATE CHANGE AND PALAEOCLIMATOLOGY

Iron isotopes and ocean evolution

The main driver for biological activity in the oceans far from land is the availability of iron, and this helps control the burial of organic carbon and hence aspects of global climate. At low Fe concentrations, as they have been since the oxygenation of the surface environment from 2 billion years ago, iron is cycled in the marine environment in a matter of a few hundred years. So, ocean water responds very quickly, in geological terms, to changes in the source of any dissolved iron. There are two main sources, discharge

of hydrothermal fluids from the oceanic lithosphere and delivery of river water and dust derived from the continents. Of the last, riverine sources probably end up in near-shore sediments and only dust contributes significantly to deep ocean water. The slowly growing nodules and crusts, composed mainly of iron and manganese compounds, on the ocean floor can chart variations in the relative proportions of these sources, because their growth produces zonation. Measurements of $d^{56}\text{Fe}$ in various materials show that the two sources are different in isotopic composition (Beard, B.L. *et al.* 2003. Iron isotope constrains on Fe cycling and mass balance in oxygenated Earth oceans. *Geology*, v. **31**, p. 629-632). While continent derived materials exude iron that is essentially the same as that in terrestrial volcanic rocks ($d^{56}\text{Fe} \sim 0.0\text{‰}$), ocean-floor hydrothermal activity is significantly depleted in ^{56}Fe ($\text{‰}^{56}\text{Fe} \sim -0.38\text{‰}$). From 6 Ma to 1.7 Ma iron-manganese crusts record iron with a dominant hydrothermal origin, but during the glaciation-dominated period since 1.7 Ma the contribution of continent-derived dusts becomes overwhelming – cooling forces drying on a global scale. Because hydrothermal contributions probably stay much the same over very long periods, because of the sluggishness of plate tectonics, iron isotopes in deep marine sediments, such as Fe-Mn crusts, may be important tracers for glacial events in the distant past, such as the glaciations during the Neoproterozoic and Palaeozoic. Interestingly, the largest iron-rich deposits on the planet, the BIFs that peaked during Archaean and Palaeoproterozoic times, record far larger excursions in iron isotopes than any other. The very low $d^{56}\text{Fe}$ values of some BIFs (down to -2.4‰) probably signify the dominance of sea-floor sources, although a non-oxidising atmosphere would have mobilised dissolved iron from the continents too, which explains the range in BIFs up to $+1.0\text{‰}$.

ECONOMIC AND APPLIED GEOLOGY

Titanic solution to unpalatable water

Currently around a billion people are at severe risk from drinking contaminated water, and whenever there is a major human crisis refugees are placed in the same plight. The main solution would seem to be drilling wells that tap groundwater that aerobic bacterial action cleanses of most pathogens. That is essentially true, but some groundwater is rejected even by people suffering the most extreme privations. It has the appearance of water from the radiator of an aged lorry, because it contains abundant dissolved iron that immediately precipitates as red-orange slime when exposed to the air, tainting food and staining clothes. A solution may arise from studies as far from drought-stricken areas as one could possibly get; concerning the way in which deep-sea wrecks decay away. The discovery of the wreck of the *Titanic* in 1985 and recovery of parts of it later by marine historian Robert Ballard, revealed that its ironworks were being consumed by bacteria that created stalactite-like masses of iron oxides, known as “rusticles”. Detailed microbiological studies found a highly complex harmony of different bacteria that created and inhabited the rusticles. Effectively, they were eating the mighty ship at a rate of about a tonne every ten days by exploiting the energy released by oxidation of iron. It may prove possible to harness the habits of these iron-loving bacteria to remove iron from groundwater and make it palatable

Source: Fry, C. 2003. Iron rations. *New Scientist*, 26 July 2003, p. 36-37.

ENVIRONMENTAL GEOLOGY AND GEOHAZARDS

Cosmogenic nuclides and tropical erosion

In the highlands of central Sri Lanka the sediment suspended in rivers suggest rates of soil loss from agricultural land of the order of up to 7000 tonnes per km^2 each year. However, it is difficult to judge how much would be eroded under natural conditions, compared with the probable loss as a result of deforestation and human activities, particularly from very rugged landscapes where seasonal rainfall is high. Radionuclides produced by cosmic-ray bombardment of minerals exposed to them, such as ^{10}Be and ^{26}Al , accumulate in soil that is being eroded at a rate that is inversely proportional to the rate of erosion. The nuclides form in the top 0.6 m of soil, which is the depth within which cosmic rays are normally absorbed. So erosion rates that can be calculated from the cosmogenic nuclides in minerals, such as quartz, in river sediments apply to the times taken to remove that depth of soil. Essentially, the rates that are measured represent the long-term erosion within a catchment basin. Swiss and Sri Lankan geoscientists have applied the technique to rivers in central Sri Lanka, whose catchments have different vegetation cover and land usage (Hewawasam, T. *et al.* 2003. Increase of human over natural erosion rates in tropical highlands constrained by cosmogenic nuclides. *Geology*, v. **31**, p. 597-600), such as forest reserves, rice terraces, tea plantations, areas of slash and burn agriculture, and various levels of degraded land. The unmodified forest catchments give the lowest long-term erosion rates of 5-11 mm per 100 ka (13-30 tonnes per km^2 per year) as expected, but this is about a quarter of the rate of erosion measured by the same method throughout the highland region. That probably reflects the antiquity of erosion induced by agriculture, yet current rates measured from sediments being carried by rivers suggests that soil erosion is now between 10 and 100 times faster than would occur under natural conditions.

Remote signs of earthquakes

All manner of ground-based observations have been tried as means of timely predictors of pending earthquakes, ranging from strange behaviour of wildlife to emissions of radon from wells (see *Radon emissions and earthquakes*, July 2003 issue of *EPN*). So far, none of them have been universally useful, although there have been successful evacuations of threatened populations, principally in China, whose seismologists have focused on a wide range of signals. Ideally, what is needed is some kind of global monitoring, and as with attempts to predict volcanic eruptions the only realistic means is from satellite surveillance. Long ago, Doug Shearman of the Royal School of Mines at Imperial College, London introduced me to the peculiar properties of the mineral dolomite, as discovered by the man whose name it takes, Count Deodar de Dolomieu. If you rub two lumps of dolomite together in a darkened room, they emit a sinister glow, and so do other minerals, such as quartz and even sugar. Excellent for amusing the kids. But then I learnt of "earth lights", which had been photographed by Japanese observers just before earthquakes, in the vicinity of active faults – previously they were supposed to be as mythological as the fire balls during thunder storms (also a proven fact now). At the time, the Landsat remote sensing satellite captured images during its night-time overpasses, on request. A nice, if a little "blue skies" research project. I submitted a brief proposal to my department's research committee for ranking along with other studentship projects. Perhaps my wry attitude to what had become somewhat dominated by other disciplines than remote sensing coloured my efforts; it was rejected. So it was with some glee, a decade later, to find that NASA and the US Federal Emergency Management Agency had been testing the idea using weather satellites and the MODIS instrument carried by the *Terra* platform since 2000 (Enriquez, A. 2003. The shining. *New Scientist*, 5 July 2003, p. 26-29). Encouragingly, though not for their victims, the devastating 1999 Izmit and 2001 Gujarat earthquakes were preceded by increased infrared emissions, detected from space, 5 days before the event. Experiments show that when rock is stressed, emissions build up, and then vanish once the rocks fails, as in an earthquake, so the method looks very promising.

Another seismic phenomenon is changing magnetic fields around the site of failure. This was first noticed from magnetometer records on the ground before the 1989 Loma Prieta earthquake that damaged large tracts of northern California. Magnetic field variations too can be monitored from orbit. The privately funded QuakeSat, launched on 30 June 2003 aims to test this possibility, as will a more ambitious French satellite, due to reach orbit in April next year (Reichhardt, T. 2003. Satellites aim to shake up quake prediction. *Nature*, v. **424**, p. 478).

GEOBIOLOGY, PALAEOLOGY, AND EVOLUTION

Setting the fossil record to rights

Much has been made of ups and downs in the diversity of life from the global fossil record of the Phanerozoic, including the possibility of massive downturns in diversity related to a variety of cause for mass extinction. However, there are many biases in what is an inevitably imperfect record of biodiversity. There are anthropogenic influences, for a start. Although they are becoming more adventurous, palaeontologists cut their teeth on sites close to home, and most of them live in the richer parts of the world. Insatiable demand for fossils, but mainly of the spectacular and valuable kinds, has grown a world-wide industry of commercial fossil mining. That may homogenise the geographic coverage of the fossil record, but it is very tempting to go for the richest troves and ignore meagre pickings. Sedimentation is by no means guaranteed to have been constant through time, partly because of ups and downs of sea level and changes in the pace of erosion of earlier rocks. Although Phanerozoic stratigraphy seems complete when sections from all over are pieced together, in any one place there are huge gaps of erosion or non-deposition. It is very easy to come upon several beds of sedimentary rock and conclude that the sequence represents a continuum in time. Not so, as any examination of such beds forming today often reveals that intact preservation is the exception compared with erosion and reworking. The global areas of exposed rocks that cover, say, 10 Ma chunks of Earth history is by no means constant either. Another factor that conspires to cast doubt on the veracity of the existing fossil record is that the numbers of possible ecological niches that once existed in different tectonic environments are probably not the same. Active oceanic arcs have few such niches, whereas tropical zones of shallow shelves have vastly more. There are lots more uncertainties, and New Zealand palaeontologists have painstakingly tried to develop some means of allowing for them in the Tertiary record of their islands (Crampton, J.S. *et al.* 2003. Estimating the rock volume bias in paleodiversity studies. *Science*, v. **301**, p. 358-360). The simplest premise for estimating bias in the numbers of taxa preserved in rocks covering a particular time range is the available volume of rock from the period that can be sampled. One approach is to see how geologists have divided up that period in terms of distinct rock formations, the other just uses estimates of the areas underlain by sedimentary rocks laid down during the period. The first suggests that collecting should be systematically from formation to formation up a sequence, while the second implies that random grid sampling is the best approach. The New Zealand data suggest that the area approach is most appropriate there, largely because the local rocks formed in a sedimentologically simple, active-margin environment. Both methods seem to work in tectonically stable areas. This is just a beginning, but it raises the issue of how much weight can be placed on existing fossil collections in pondering on both titanic and slow-but-sure episodes in the last 544 Ma.

On the same tack, attempts are underway to correct the entire fossil record from 30 thousand collections, using a similar approach to sampling bias. John Alroy at the University of California, Santa Barbara has helped set up the Paleobiology Database (<http://flatpebble.nceas.ucsb.edu/public/>), following prompting by the most prolific fossil cataloguer, Jack Sepkoski, shortly before his untimely death in 1999. The web site allows anyone to generate diversity curves, but the process is a little complicated and best tackled by experienced palaeontologists. You can also enter information from your own collections. Early results are conflicting. Sepkoski's original suggestion that diversity among marine faunas increased since the Triassic may be an artefact of the intensity of sampling which varies from age to age. However, using just molluscs seems to confirm that at least they did indeed radiate tremendously as Sepkoski had concluded (Schiermeier, Q. 2003. Setting the record straight. *Nature*, v. **424**, p. 482-483).

Origins of the vertebrates

Long before techniques were developed to investigate the genetic stuff of living organisms, and when the only known repository of primitive, soft-bodied animals was the Burgess Shale, basic anatomical analysis suggested that maybe the ancestors of vertebrates were worms, sea squirts and even echinoderms. When the Burgess Shale fauna was re-evaluated and extended in the 1970's by, among others, Simon Conway Morris of Cambridge University, it became clear that the fossil record was missing a great many delicate and sometimes very odd organisms. Entirely unsuspected phyla numbered among the occupants of that famous *lagerstätte* (site of exceptional preservation), but little new about our own ultimate origins.

Vertebrates, echinoderms, sea squirts and a diverse collection of worm-like animals have one thing in common, though apparently very little else. The first opening to emerge during embryonic development is the anus, whereas in the rest of the animals (protostomes) it becomes a mouth. So, in the "supergroup" to which we belong, mouths appear at a later developmental stage; hence the sack-name "deuterostome". This oddly dichotomous embryonic unfolding points to a very early division among the animals, that might only be unveiled by discovery of even earlier *lagerstätten* than the Late Cambrian Burgess Shale. So far, no such source of palaeontological richness has been discovered in late Precambrian sedimentary rocks – crude "molecular clock" approaches to genetic divergence suggest that a great deal went on before the Cambrian Explosion at 544 Ma. However, the fossil-rich Cambrian of China does push back the record of delicate animals almost to that time. The recently discovered *lagerstätte* of Chengjiang is about 530 Ma old, and, as Conway Morris and his Chinese colleagues have discovered, it is rich in fossil deuterostomes. One group, the vetulicolians, bears a remarkable resemblance to what the pioneer vertebrate palaeontologist, Alfred Romer, suggested as a probable vertebrate ancestor – something with a front end bearing gill slits and a long, segmented tail. The Chengjiang deposit also contains jawless fish, together with unique "almost fish" called yunnanozoans that may be intermediate links between vetulicolians and fish. Similarly, there are intriguing hints that vetulicolians evolved towards the most primitive echinoderms, with bilateral symmetry rather than the fivefold form that emerged later. Clearly, the Chengjiang fauna was extremely diverse and therefore had a long evolutionary history. Since even more delicate, entirely soft-bodied Ediacaran animals were preserved as imprints in sandstones from the Late Neoproterozoic, it is maybe only a matter of time before low-energy *lagerstätten* are found from that time. There are abundant undeformed mudstones from that period throughout the world, but only painstaking rock splitting will find such treasures, unlike the large, "trip-over" Ediacaran trace fossils.

Source: Conway Morris, S. 2003. Once we were worms. *New Scientist*, 2 August 2003, p. 34-37.

PLANETARY, EXTRATERRESTRIAL GEOLOGY, AND METEORITICS

Glaciers of Mars

The world has been agog these last few years as evidence has mounted to suggest that Mars still has abundant water buried beneath its dusty surface, in the form of permafrost. Early in its history there are many signs of vast floods that carved huge meandering canyons and may have filled basins with moderately long-lived seas. Yet Mars has probably always been pretty cold, as it is now, and the most likely form that surface water would have taken is in glaciers; that is, if there was ever sufficient atmospheric water to precipitate snow. As on Earth, the likeliest places to look are in mountainous regions, and Mars is not lacking in very high places. By far the largest, and indeed they are the highest mountains in the Solar System, are the shield volcanoes of the Tharsis Rise, topping out around 18 km above the Martian version of the geoid. The volcanoes have gnarled surfaces, which until recently have been regarded by most as the result of volcano-related processes. Imaging of the Martian surface has stepped up several notches in resolution in recent years, and details of the small-scale features of the volcanoes are very clear. Above all else, they resemble aspects of the nearest analogue to Martian conditions on Earth – the Dry Valleys of Antarctica. Although the Dry Valleys are now largely free of ice sheets, they show many features of former glaciation, perhaps extending back 30 Ma to the Oligocene. Their frigidity has ensured that any glaciers there were frozen to the surface, rather than having zones of incipient melting at their bases. Such cold-based glaciers move sluggishly, and produce peculiar features. Among these are moraines produced by sublimation rather than melting of the ice – they evidence no

reworking by melt water – and rock glaciers that are also products of sublimation and sometimes rest on relics of former glaciers. Probable examples of both occur on the flanks of the Tharsis volcanoes, together with weird track-like assemblies of concentric ridges, that are likely to have formed on the flanks of ablating glaciers as they reached a standstill and then retreated. (Head, J.W. & Marchant, D.R. 2003. Cold-based mountain glaciers on Mars: Western Arsia Mons. *Geology*, v. **31**, p. 641-644). Interestingly, the relationship of the glacial features to impact craters suggests that glaciation took place during the period since about 1.8 billion years ago (the Amazonian phase of Mars' history) when bombardment had slackened to almost terrestrial rates and liquid water was unable to form on the red planet. Of course, glaciers do not have to be made of water ice, and there is still a possibility that at such immense altitudes any glaciers might have been made of solid carbon dioxide. Head and Marchant speculate that some of the features might still sit upon relics of the glaciers. It could be a bit of a disappointment if future explorers of Mars landed there expecting a water supply.

REMOTE SENSING

Imaging radar and WMD

A short article in *New Scientist* (Morris, H. 2003. Satellites hunt for buried treasure. *New Scientist* 12 July 2003, p. 12-13) reminded me of the puzzling failure of British and US forces in Iraq to discover any buried caches of weapons of mass destruction, either before the invasion of Iraq or in the aftermath of Saddam Hussein's disappearance. Researchers at the Ben Gurion University of the Negev in Israel have tested the ground-penetrating capabilities of imaging radar that uses microwave pulses with various wavelengths. One of the principles of radar remote sensing is that microwaves can penetrate beneath the Earth's surface, provided the materials contain little liquid water. The longer the wavelength the greater the depth from which information can be sensed. Ground-penetrating radar is a common tool in archaeological investigations and in glaciology (ice is "dry"), but is usually deployed along ground traverses. The Israeli experiments, which duplicated work done by remote sensing researchers at NASA's Jet Propulsion Laboratory, used airborne imaging radar to detect buried metal target, which are highly reflective to microwaves. They used microwaves with moderately long wavelength, and showed that objects half a metre deep were easily detected.

Radar with a wavelength of around 70 cm is called P-band radar, and has the greatest potential for sub-surface mapping, with penetration up to 9 metres. In 1987, NASA's Jet Propulsion Laboratory first flew an airborne radar imaging system (AIRSAR) that uses P-band, partly to exploit its ability to "see through" dense vegetation but also to produce ground-penetrating images in dry regions. AIRSAR has the potential to produce images with a resolution of 3.3 metres, and data produced by it have been available freely to civilian users. It would be no surprise, therefore, if there were imaging radar systems with P-band radar being used for intelligence gathering. The US National Imagery and Mapping Agency (NIMA), in conjunction with JPL and EarthData International, Inc., developed in 2000 the 2-metre resolution Geographic Synthetic Aperture Radar (GeoSAR) mapping system, that also includes a P-band imager. GeoSAR is funded by the US Defense Advanced Research Projects Agency (DARPA). NIMA, formerly the US Defense Mapping Agency, is a Department of Defense Combat Support and National Intelligence Community agency that provides imagery, image intelligence and geospatial information in support of US national security objectives. The French and Italian space agencies are also discussing the development such systems, perhaps to be deployed from orbit by the European Space Agency.

It was NASA/JPL's Shuttle Imaging Radar missions in the 1980s and 90s that revealed dramatic evidence for former tributaries of the Nile River System that are buried beneath the sands of the arid eastern Sahara desert in Egypt and Libya. Although not so dry, the Tigris-Euphrates plain is a desert, and it would be very surprising if P-band radar imaging has not been used in the search for buried WMD. Since radar energy is barely affected by the atmosphere, and the microwaves used in radar imaging are effectively highly focussed laser beams, systems carried on satellites have the same spatial resolution as those carried on aircraft. Had a P-wave system been deployed on a military surveillance aircraft or satellite, then sizeable buried caches would have been difficult to miss. Even if the ground was damp, one of radar's other features is that it responds to variations in the texture of the ground surface. Reworked soil over excavations would be easily spotted by any radar imaging system, either orbiting or on an aircraft. So it was somewhat odd when the US Secretary of State, Colin Powell, did not use any imaging radar evidence in his submission to the UN Security Council on 5 February 2003.

TECTONICS

Zircons that wander

The crust beneath the British Isles is made up of several once widely separated terranes, parts of Laurentia, an arc segment called Avalonia that split from Gondwana around 500 Ma ago, and a similar terrane (Armorica) that followed Avalonia across the Iapetus Ocean to accrete to Laurentia at the end of the Palaeozoic Era. Because of its maritime position, modern Britain is cloaked in vegetation so that rock occurrences are few and far between by comparison with less humid areas. Conditions for geological investigations are made yet worse by a mantle of glacial sediments plastered on top of bedrock. So,

although having been studied for longer than almost every other piece of continental crust, the evolution of that beneath the British Isles is a subject of continual controversy and surprises. Sitting at the interface between the Laurentian and Avalonian terranes, roughly where the Iapetus suture is thought to have consumed at least half of the eponymous ocean, sit the Lower Palaeozoic rocks of the Southern Uplands of Scotland. They are widely thought to have formed as an accretionary prism on the edge of the plate underidden by subducted Iapetus oceanic lithosphere until Avalonia collided with the north-British terranes at the close of the Silurian. Some of the Ordovician sediments in the pile contain clasts of volcanic rocks, which were long thought to be contemporary and giving evidence of the expected arc volcanism behind the prism. However, they turn out to be much older, now that zircons from the sediments have been dated using high-precision methods (Phillips, E.R. and 7 others 2003. Detrital Avalonian zircons in the Laurentian Southern Uplands terrane, Scotland. *Geology*, v. **31**, p. 625-628). The zircons yielded Neoproterozoic ages (557 to 613 Ma), with evidence that some had been assimilated from older crust (1043 Ma) during volcanism. Taken at face value, the Neoproterozoic ages are similar to those of volcanic rocks in England and Wales, which formed off Gondwana in an arc setting, when the terranes were widely separated. The problem is one of getting the material across the subduction zone that separates the accreted terranes, but that is the issue proposed by the authors (all from the Natural Environment Research Council. However, such a conclusion might stem from the authors' narrow context; that of British geology. Immediately to the north of the Southern Uplands terrane is another, poorly exposed crustal block that underlies the Scottish Midland Valley. It was directly involved in the Ordovician Grampian orogeny that formed the highly deformed Precambrian rocks of the Scottish Highlands. With a narrow view, that terrane is also a mystery, yet it has a counterpart in the Taconia terrane that is familiar to North American geologists, which was involved in orogenic events contemporary with the Grampian orogeny in Scotland. Taconia has late Neoproterozoic to Ordovician arc volcanics.

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