

CM²



MAGAZINE

第 2 期



南方科技大学海洋磁学中心主编

创刊词

海洋是生命的摇篮，是文明的纽带。地球上最早的生命诞生于海洋，海洋里的生命最终进化成了人类，人类的文化融合又通过海洋得以实现。人因海而兴。

人类对海洋的探索从未停止。从远古时代美丽的神话传说，到麦哲伦的全球航行，再到现代对大洋的科学钻探计划，海洋逐渐从人类敬畏崇拜幻想的精神寄托演变成可以开发利用与科学研究的客观存在。其中，上个世纪与太空探索同步发展的大洋科学钻探计划将人类对海洋的认知推向了崭新的纬度：深海（deep sea）与深时（deep time）。大洋钻探计划让人类知道，奔流不息的大海之下，埋藏的却是亿万年的地球历史。它们记录了地球板块的运动，从而使板块构造学说得到证实；它们记录了地球环境的演变，从而让古海洋学方兴未艾。

在探索海洋的悠久历史中，从大航海时代的导航，到大洋钻探计划中不可或缺的磁性地层学，磁学发挥了不可替代的作用。这不是偶然，因为从微观到宏观，磁性是最基本的物理属性之一，可以说，万物皆有磁性。基于课题组的学科背景和对海洋的理解，我们对海洋的探索以磁学为主要手段，海洋磁学中心因此而生。

海洋磁学中心，简称 CM^2 ，一为其全名“Centre for Marine Magnetism”的缩写，另者恰与爱因斯坦著名的质能方程 $E = MC^2$ 对称，借以表达我们对科学巨匠的敬仰和对科学的不懈追求。

然而科学从来不是单打独斗的产物。我们以磁学为研究海洋的主攻利器，但绝不仅限于磁学。凡与磁学相关的领域均是我们关注的重点。为了跟踪反映国内外地球科学特别是与磁学有关的地球科学领域的最新研究进展，海洋磁学中心特地主办 CM^2 Magazine，以期与各位地球科学工作者相互交流学习、合作共进！

“海洋孕育了生命，联通了世界，促进了发展”。21世纪是海洋科学的时代，由陆向海，让我们携手迈进中国海洋科学的黄金时代！

目 录

1. 中新世以来太平洋-大西洋流通性的减弱提高北大西洋径向翻转流的强度. . 1
2. 重晶石在海洋中—产状、地球化学和古海洋学应用..... 4
3. 寒武纪动物辐射与氧气急剧扰动的可能联系..... 6
4. 由斜长石中熔体包裹体揭示的大洋中脊火山之下的深部岩浆根部..... 8
5. 华南与冈瓦纳的连接与裂解—来自华南中泥盆世红层的古地磁新约束..... 10
6. 中国南方石笋中的磁信号与冰期-间冰期旋回期间的古地貌重建..... 12
7. 马里亚纳火山弧海山沉积物中细菌群落结构及新种类趋磁细菌研究..... 14
8. 通过大塔穆火山 (Tamu Massif) 的磁异常分析海底扩张形成的洋底高原. 16
9. 中国东南地区降水同位素比值的日际至年际变化的区域控制：对古季风重建的启示..... 18
10. 过去 850,000 年以来气候与亚北极太平洋营养盐上涌的协同变化..... 20

1. 中新世以来太平洋-大西洋流通性的减弱提高北大西洋径向翻转流的强度

翻译人: 仲义 zhongy@sustech.edu.cn



Valeriia Kirillova, Anne H. Osborne, Tjordis Storling, et al. Miocene restriction of the Pacific-North Atlantic throughflow strengthened Atlantic overturning circulation[J]. Nature Communications, 2019, 10(1): 4025.

摘要: 加勒比海与北大西洋之间的温盐环流作用是北大西洋径向翻转流 (AMOC) 重要组成部分。然而, 前人发现中新世以来 AMOC 开始增强, 可能是由于中美海道的打开作用促进了低盐度太平洋环流进入加勒比海。为了解释这个争议, 研究人员首次通过佛罗里达海峡海洋沉积物的 Nd 同位素记录了 12.5 Ma 以来中层水的变化。结果表明, 从 11.5-9.5 Ma 之间, 没有明显中层水从加勒比海进入佛罗里达海峡, 与此同时 AMOC 持续增强。9 Ma 之后, 由于中美海道的关闭阻止了低盐度的太平洋水进入加勒比海, 使得 AMOC 继续增强。

ABSTRACT: Export of warm and salty waters from the Caribbean to the North Atlantic is an essential component of the Atlantic Meridional Overturning Circulation (AMOC). However, there was also an active AMOC during the Miocene, despite evidence for an open Central American Seaway (CAS) that would have allowed low-salinity Pacific waters to enter the Caribbean. To address this apparent contradiction and to constrain the timing of CAS closure we present the first continuous Nd isotope record of intermediate waters in the Florida Strait over the past 12.5 million years. Our results indicate that there was no direct intermediate water mass export from the Caribbean to the Florida Strait between 11.5 and 9.5 Ma, at the same time as a strengthened AMOC. After 9 Ma a strong AMOC was maintained due to a major step in CAS closure and the consequent cessation of low-salinity Pacific waters entering the Caribbean.

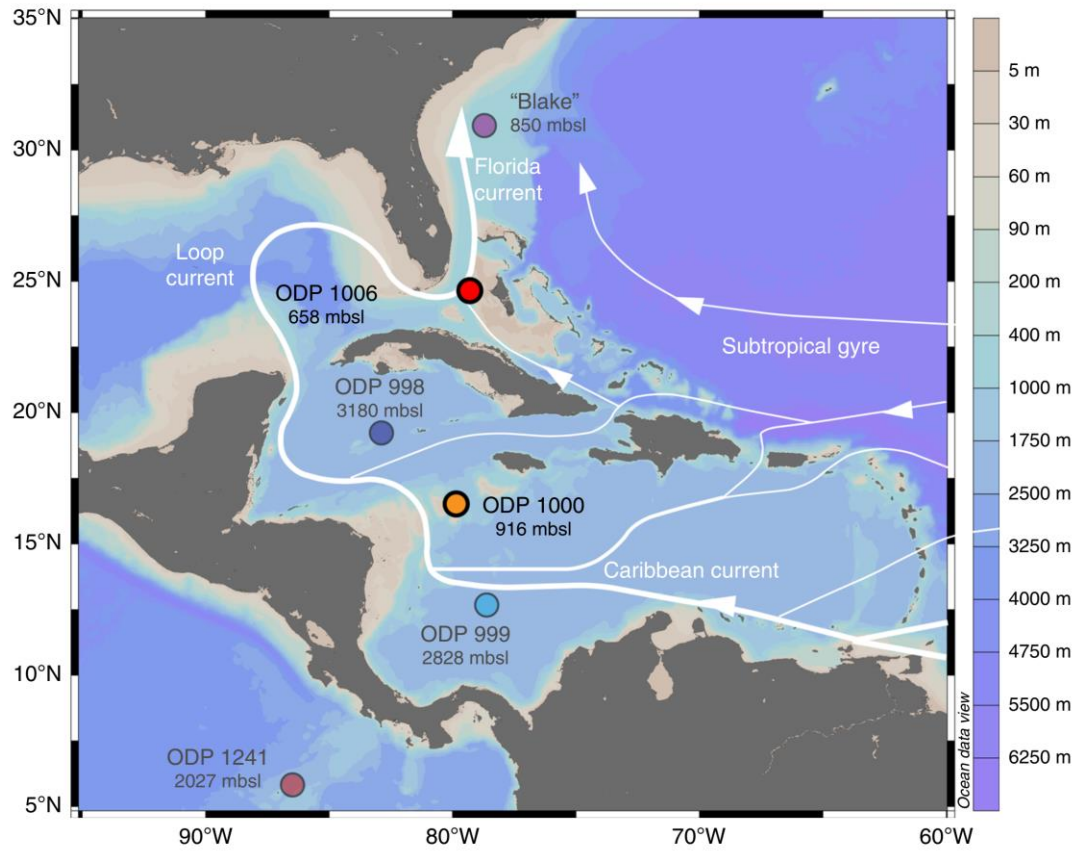


Figure 1. Study area and sample sites. Locations and water depths of Ocean Drilling Program (ODP) Sites from which the new data were obtained (1000 and 1006) and of other sites referred to in this study (ODP 998, 999 and 1241, Blake crust). The main ocean currents affecting the sites are shown in white. Map produced using Ocean Data View.

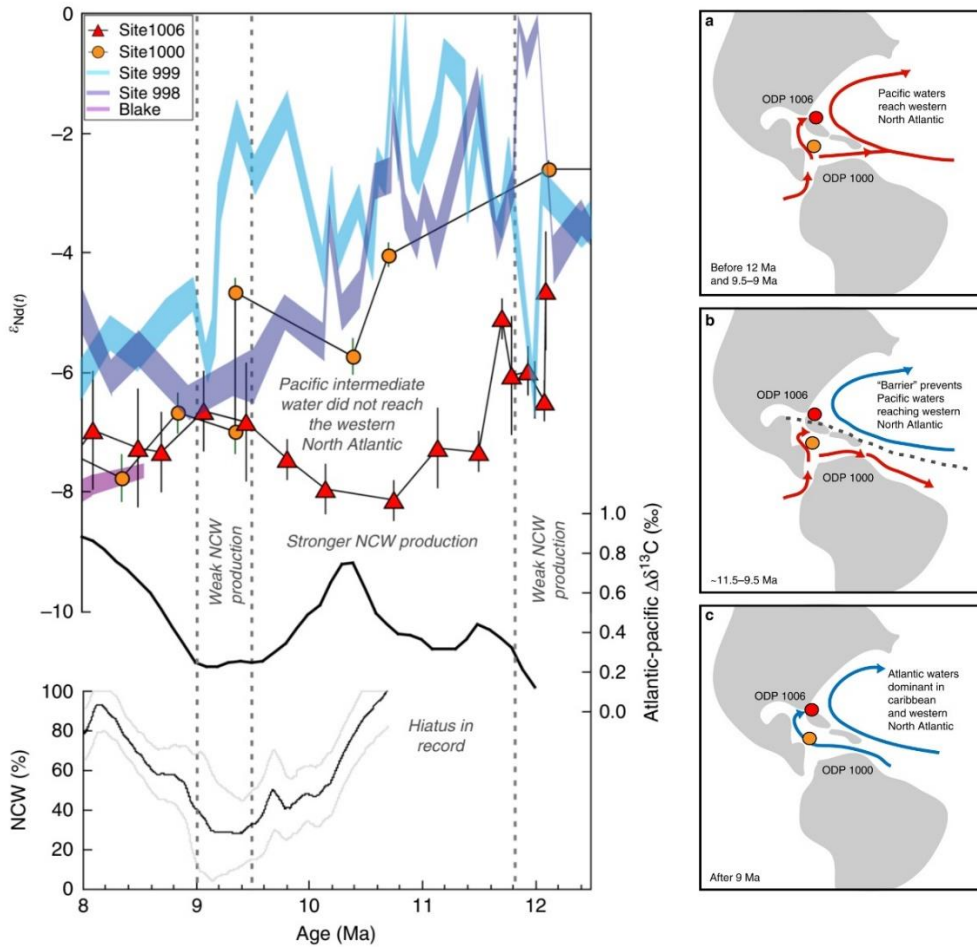


Figure 2. Schematic representation of different circulation patterns as the Central American Seaway shoaled. a) Intermediate-depth water from the Pacific reaches the western North Atlantic, either directly via the Florida Strait, or indirectly via entrainment in the Atlantic gyre. Site 1000 (orange circle) and Site 1006 (red circle) both have radiogenic ϵ_{Nd} signatures. b) A barrier (dashed grey line), either physical or hydrographical, prevents Pacific intermediate waters from reaching the western North Atlantic. Site 1000 has a more radiogenic signal than Site 1006. c). The Central American Seaway has shoaled sufficiently so that the Atlantic is the dominant source of intermediate waters to the Caribbean. The detrital signal at Site 1000 changes towards that of the Orinoco after 9 Ma.

2. 重晶石在海洋中—产状、地球化学和古海洋学应用

翻译人: 芦阳 luyang_sz@foxmail.com



Griffith M. E., Paytan, A. *Barite in the ocean-occurrence, geochemistry and palaeoceanographic applications*[J]. *Sedimentology*, 2012, 59: 1817-1835.

摘要: 重晶石可以形成在多种海洋背景中: 海水中、海底和海洋沉积物中, 重晶石形成的背景最终决定了沉积矿物的地球化学和它的多种应用的使用力。特别的, 重晶石的主量和微量的同位素和元素成分保存了沉积流体的信息。海水中形成的重晶石记录了海水化学的变化。在沉积物中或者海底孔隙水环境中沉积的重晶石可以用来研究沉积物中流体和氧化还原过程。与热液活动有关的重晶石提供热液周围地壳蚀变的条件信息。远洋氧化性沉积物中海洋重晶石的富集可以用来重建海洋生产力的改变。未来研究重晶石出现和来源的领域包括: 完全解决海水中重晶石形成的机制; 研究细菌在重晶石形成中的角色和潜在的重要性; 定量控制重晶石保存在沉积物中的控制参数; 明确成岩作用对重晶石地化特征的影响; 研究重晶石中额外微量元素的应用。

ABSTRACT: The mineral barite (BaSO_4) can precipitate in a variety of oceanic settings: in the water column, on the sea floor and within marine sediments. The geological setting where barite forms ultimately determines the geochemistry of the precipitated mineral and its usefulness for various applications. Specifically, the isotopic and elemental composition of major and trace elements in barite carry information about the solution(s) from which it precipitated. Barite precipitated in the water column (marine or pelagic barite) can be used as a recorder of changes in sea water chemistry through time. Barite formed within sediments or at the sea floor from pore water fluids (diagenetic or cold seeps barite) can aid in understanding fluid flow and sedimentary redox processes, and barite formed in association with hydrothermal activity (hydrothermal barite) provides information about conditions of crust alteration around hydrothermal vents. The accumulation rate of marine barite in oxic-pelagic sediments can also be used to reconstruct past changes in ocean productivity. Some key areas for future work on the occurrence and origin of barite include: fully characterizing the mechanisms of precipitation of marine barite in the water column; understanding the role and potential significance of bacteria in barite precipitation; quantifying

parameters controlling barite preservation in sediments; determining the influence of diagenesis on barite geochemistry; and investigating the utility of additional trace components in barite.

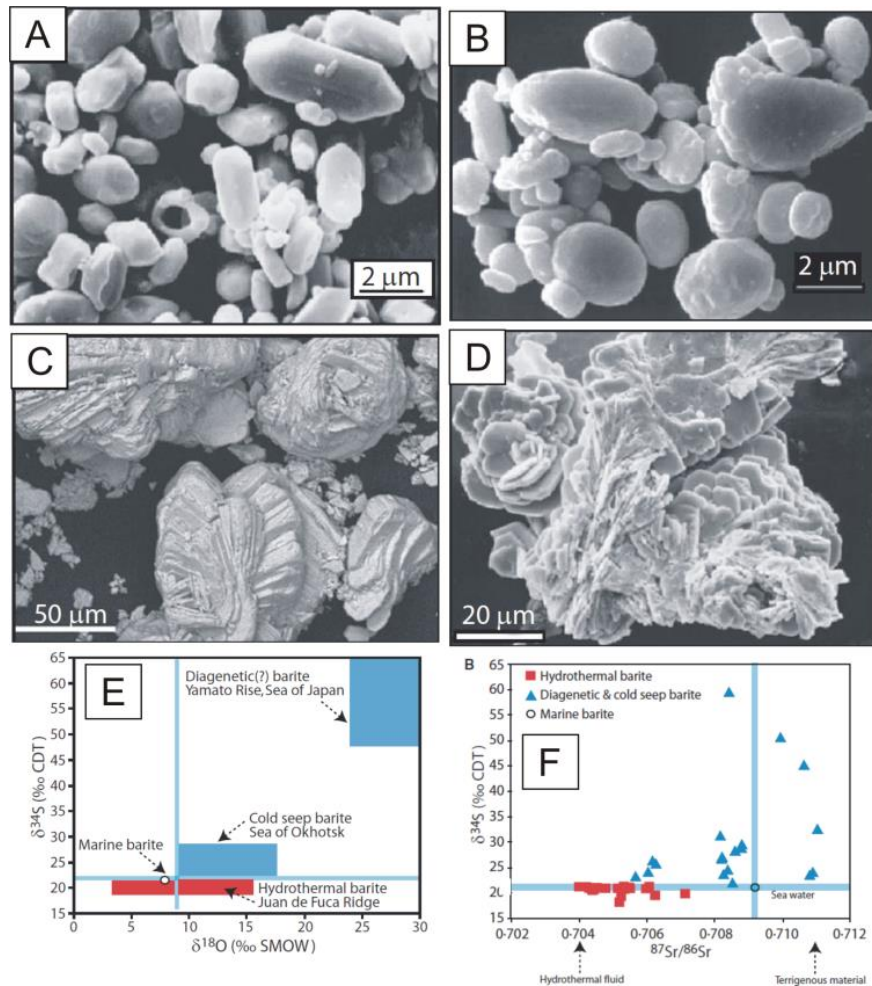


Figure 1. Scanning electron micrographs of barite crystals, some images are adapted from Paytan et al. (2002). (A) Euhedral to sub-spherical marine barite, core-top sediments, Pleiades expedition, core 77, 1.03 °N, 119.55 °W. (B) Sub-spherical to elliptical marine barite, sediment trap, <8 km fraction from Juan de Fuca Ridge black smoker. (C) Platy tabular diagenetic barite, Baja California, Ensenada dredged sample. (D) Rosette structures of hydrothermal barite, Mid-Atlantic Ridge, chimney at Lucky Strike, ALV 2602-3. Images (A), (B) and (D) were taken in secondary electron mode. Image (C) was taken in back scatter mode. (E) Plot of the sulphur and oxygen isotopic composition of barite. Juan de Fuca O and S isotope data are from Goodfellow et al. (1993) and Paytan et al. (2002), respectively. Sea of Okhotsk data are from Greinert et al. (2002) and Sea of Japan data are from Sakai (1971). Marine barite S isotope data are from Paytan et al. (1998) and O isotope data are from Turchyn & Schrag (2004). Average marine barite O isotope data were based on measurements of recent marine barite from five sites (Turchyn & Schrag, 2004). The reason for the apparent offset between marine barite and sea water $\delta^{18}\text{O}$ SO_4 compels further investigation. (F) Plot of the S and Sr isotopic composition of barite. All data are from Paytan et al. (2002). Light blue lines designate the modern sea water isotopic composition of each element.

3. 寒武纪动物辐射与氧气急剧扰动的可能联系



翻译人：蒋晓东 jiangxd@sustech.edu.cn

He, T, Zhu, M, Mills, B.J. et al. *Possible links between extreme oxygen perturbations and the Cambrian radiation of animals*[J]. *Nature geoscience*, 2019. 12(6): 468.

摘要：氧气驱动早期动物的演化一直存在广泛的争议。在寒武纪，动物种类一系列的辐射与碳同位素波动相关。然而驱动这些碳同位素波动的因素仍然未知，其与环境中氧气的潜在联系亦是未解。本文对取自西伯利亚东南台地的海相碳酸盐进行高分辨率的碳、硫同位素分析，结果显示典型的寒武纪动物爆发是在 524 到 514 Myr 前。数据揭示碳酸盐碳同位素与碳酸盐相关的硫同位素在 5 个周期内具有强烈的正相关性。生物地球化学模型表明这两组同位素共同反应大气与大洋表层氧气的周期性振动。在此振动期间，动物门类的多样性最大值与氧气急剧扰动一致。反过来，随后的 Botoman-Toyonian 动物灭绝事件（514 到 512 Myr 前）与解耦的同位素记录一致，该结果指示减少的海洋硫酸盐残余和扩张的海洋表层缺氧层。我们认为在动物早期历史至关重要的阶段，海洋表层区域氧气的波动是生物多样性辐射发生时间的主要控制因素。

ABSTRACT: The role of oxygen as a driver for early animal evolution is widely debated. During the Cambrian explosion, episodic radiations of major animal phyla occurred coincident with repeated carbon isotope fluctuations. However, the driver of these isotope fluctuations and potential links to environmental oxygenation are unclear. Here we report high-resolution carbon and sulfur isotope data for marine carbonates from the southeastern Siberian Platform that document the canonical explosive phase of the Cambrian radiation from ~ 524 to ~ 514 Myr ago. These analyses demonstrate a strong positive covariation between carbonate $\delta^{13}\text{C}$ and carbonate-associated sulfate $\delta^{34}\text{S}$ through five isotope cycles. Biogeochemical modelling suggests that this isotopic coupling reflects periodic oscillations in the atmospheric O_2 and the extent of shallow-ocean oxygenation. Episodic maxima in the biodiversity of animal phyla directly coincided with these extreme oxygen perturbations. Conversely, the subsequent Botoman–Toyonian animal extinction events (~ 514 to ~ 512 Myr ago) coincided with decoupled isotope records that suggest a shrinking marine sulfate

reservoir and expanded shallow marine anoxia. We suggest that fluctuations in oxygen availability in the shallow marine realm exerted a primary control on the timing and tempo of biodiversity radiations at a crucial phase in the early history of animal life.

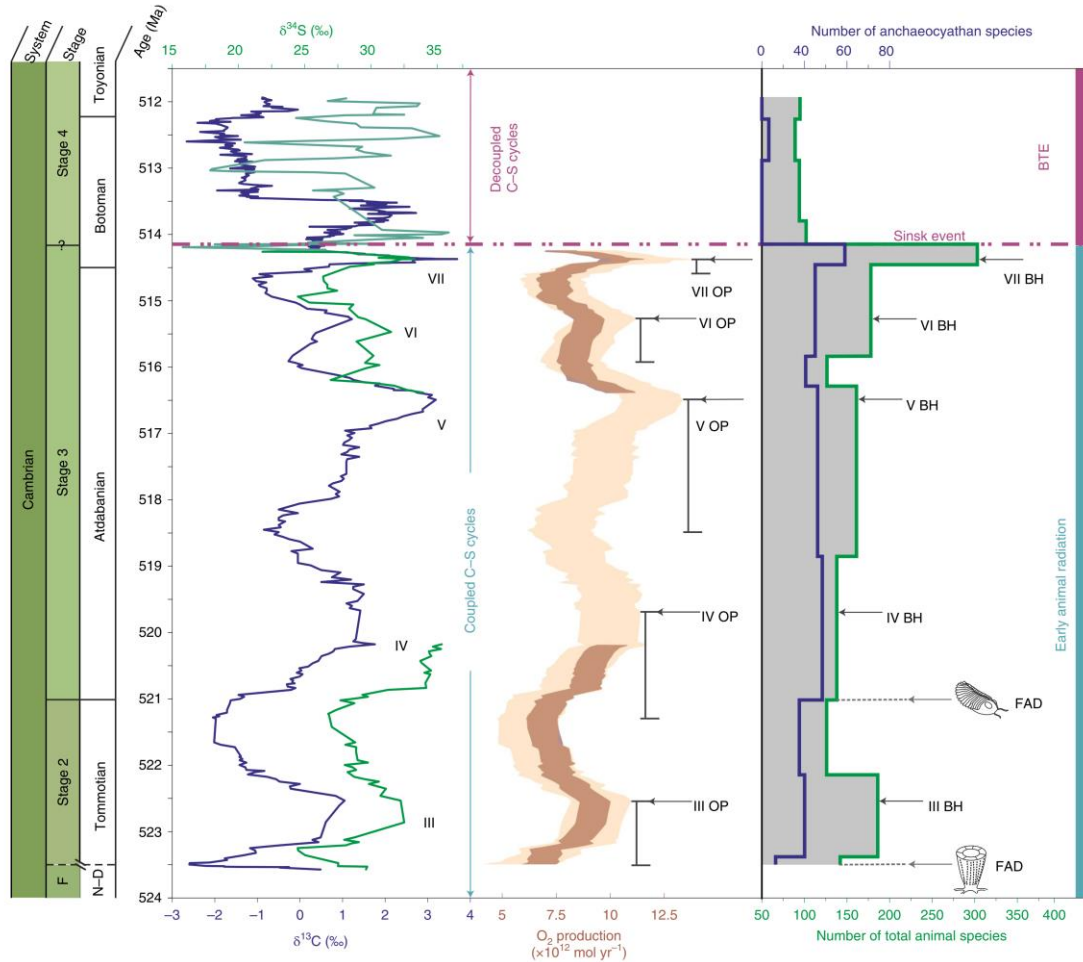


Figure 1. Animal diversity, biological events and their correlation to the isotope records and oxygenation pattern across Cambrian Stages 2-4. Global oxygen production is inferred from isotope mass balance modelling using inputs of $\delta^{13}\text{C}$ only (light shade) or $\delta^{13}\text{C}$ and $\delta^{34}\text{S}$ (dark shade). Archaeocyathan species (blue line) and total animal species (green line) diversity records are expressed as the mean number of species per sampling unit (grey box) in Siberia. OP, oxygenation pulse; BH, biodiversity high.

4. 由斜长石中熔体包裹体揭示的大洋中脊火山之下的深部岩浆根部



翻译人：冯婉仪 fengwy@sustech.edu.cn

Bennett E N, Jenner F E, Millet M A, et al. Deep roots for mid-ocean-ridge volcanoes revealed by plagioclase-hosted melt inclusions[J]. Nature, 2019, 572(7768): 235-239.

摘要：全球的大洋中脊体系是地球上最为广泛的岩浆体系并且是 75% 的地球火山活动喷发的地方。前人认为大洋中脊的岩浆系统在垂向上的延伸范围是有限的，即使是在北冰洋之下的扩张速率十分缓慢的 Gakkel 大洋中脊的岩浆系统也是如此，该地区的岩石圈厚度大，但岩浆结晶的深度也被认为不超过 9 km。这些深度的确定是利用包裹体（矿物结晶时捕获的少量岩浆）中的挥发分含量得到的。玄武质岩浆体系的研究往往选择的矿物是橄榄石。然而，利用橄榄石中熔体包裹体成分得到的压力与利用玄武岩全岩主量元素成分得到的压力以及地球物理方法测量的岩石圈深度不一致。本文展示了 Gakkel 大洋中脊采集的样品中橄榄石熔体包裹体和斜长石熔体包裹体的对比研究。研究结果显示斜长石中熔体包裹体挥发分含量对应的结晶压力（平均值为 270 Pa）大于橄榄石中熔体包裹体挥发分含量对应的结晶压力（平均值为 145 Pa）。斜长石中熔体包裹体记录的最大压力对应于距海底之下 16.4 km。这个深度与 Gakkel 大洋中脊岩石圈的厚度以及利用玻璃成分估算的压力大小一致。与以往以橄榄石中熔体包裹体为基础的研究不同，我们的结果证明了大洋中脊之下，至少是扩张速率很慢的大洋中脊之下可能存在岩石圈地幔深度的岩浆根。

ABSTRACT: The global mid-ocean ridge system is the most extensive magmatic system on our planet and is the site of 75 per cent of Earth's volcanism. The vertical extent of mid-ocean-ridge magmatic systems has been considered to be restricted: even at the ultraslowspreading Gakkel mid-ocean ridge under the Arctic Ocean, where the lithosphere is thickest, crystallization depths of magmas that feed eruptions are thought to be less than nine kilometres. These depths were determined using the volatile-element contents of melt inclusions, which are small volumes of magma that become trapped within crystallizing minerals. In studies of basaltic magmatic systems, olivine is the mineral of choice for this approach. However, pressures derived from olivine-hosted melt inclusions are at odds with pressures derived from basalt major-element barometers and

geophysical measurements of lithospheric thickness. Here we present a comparative study of olivine- and plagioclase-hosted melt inclusions from the Gakkel mid-ocean ridge. We show that the volatile contents of plagioclase-hosted melt inclusions correspond to much higher crystallization pressures (with a mean value of 270 megapascals) than olivine-hosted melt inclusions (with a mean value of 145 megapascals). The highest recorded pressure that we find equates to a depth 16.4 kilometres below the seafloor. Such higher depths are consistent with both the thickness of the Gakkel mid-ocean ridge lithosphere and with pressures reconstructed from glass compositions. In contrast to previous studies using olivine-hosted melt inclusions, our results demonstrate that mid-ocean-ridge volcanoes may have magmatic roots deep in the lithospheric mantle, at least at ultraslow-spreading ridges.

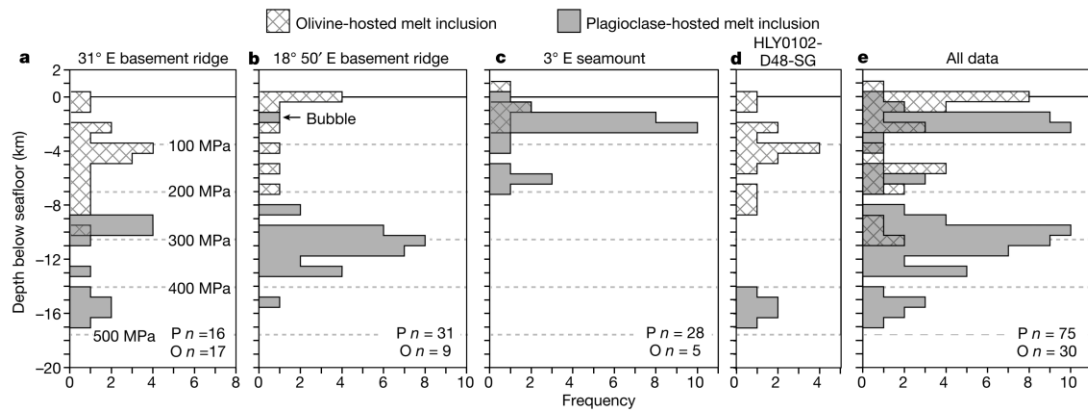


Figure 1. Comparison of crystallization depths recorded in melt inclusions. Histograms showing the distribution of crystallization depths recorded in olivine- and plagioclase-hosted melt inclusions at three locations along the Gakkel Ridge. a, 31° E basement ridge. b, 18° 50' E basement ridge. c, 3° E seamounts. d, Comparison of pressures recorded by olivine- and plagioclase-hosted melt inclusions in a single sample (HLY0102-D48-SG) from 31° E basement ridge; olivine data here are from ref. 3. All data are compared in d. Pressures correspond to the pressure below the seafloor. Frequency indicates the number of analyses. O, Olivine; P, plagioclase.

5. 华南与冈瓦纳的连接与裂解-来自华南中泥盆世红层的古地磁新约束



翻译人: 刘伟 ineway@163.com

Xian H, Zhang S, Li H, et al. How Did South China Connect to and Separate From Gondwana? New Paleomagnetic Constraints From the Middle Devonian Red Beds in South China[J]. Geophysical Research Letters, 2019, 46(13): 7371-7378.

摘要: 华南与冈瓦纳的古地理关系对认识冈瓦纳的分布、亚洲的增生和古特提斯的演化具有重要意义。然而, 由于缺乏可靠的泥盆纪古地磁资料, 无法证实华南与冈瓦纳的连接及其在古生代的分离。本文报道了一个产自中南地区吉维特阶红层 (~385 Ma) 的古地磁级 (33.6° N, 236.4° E; A95 = 3°)。华南与冈瓦纳极移路径的拟合表明, 早在寒武纪至泥盆世早期, 华南就与冈瓦纳东部相连, 其位置靠近澳大利亚西北部。此后, 华南在~400-385 Ma 期间与冈瓦纳分离, 其明显的极移路径是解耦的。古地磁资料表明, 360 Ma 时中国南部和冈瓦纳东部之间的古特提斯海的纬向度宽度约为 1600 公里。

ABSTRACT: The paleogeographic relationship between South China and Gondwana is critical for understanding the dispersion of Gondwana, accretion of Asia, and evolution of the Paleo Tethys. However, the lack of robust Devonian paleomagnetic data prevents a confirmative reconstruction of South China's connection to Gondwana and its subsequent separation during the Paleozoic. Here we report a new paleopole (33.6° N, 236.4° E; A95 = 3°) from the Givetian red beds (~385 Ma) in central South China. Fitting apparent polar wander paths between South China and Gondwana suggests that South China was connected to East Gondwana from the earliest Cambrian to Early Devonian, with its position closed to NW Australia. Thereafter, South China separated from Gondwana during ~400-385 Ma, as evidenced by their decoupled apparent polar wander paths. The paleomagnetic data suggest that the Paleo Tethys Ocean between South China and East Gondwana had been up to ~1,600 km latitudinally wide by ~360 Ma.

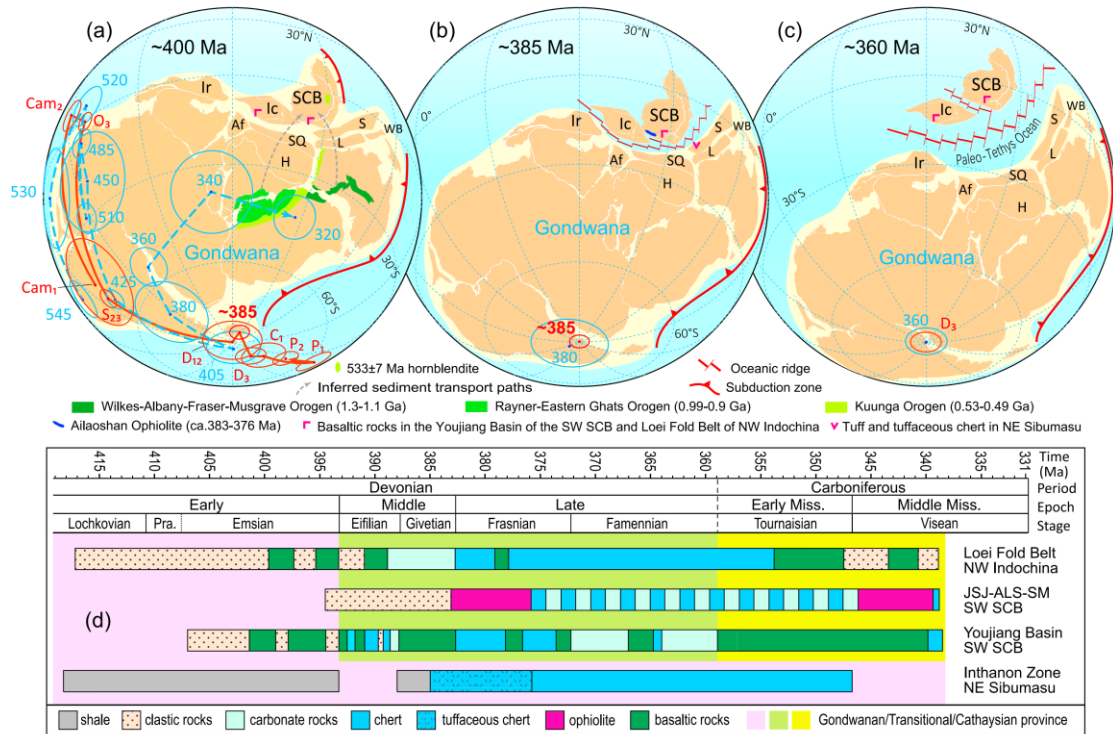


Figure 1. Paleogeographic reconstructions at (a) ~ 400 Ma, (b) ~ 385 Ma, and (c) ~ 360 Ma. The fit of Gondwana is mainly modified after Torsvik et al. (2012), except for the relative position of Madagascar–India–Sri Lanka to Africa and Antarctica, which is adopted from Reeves et al. (2016) as a tight reconstruction based on the updated ocean-floor fracture zone data of the Indian Ocean. The poles and labels of Gondwana are colored blue. The SCB poles are marked as orange circles with red labels. The ages of all number-labeled paleopoles are in Ma. Orogenic belts in (a), including the Wilkes–Albany–Fraser–Musgrave (1.3–1.1 Ga), Rayner–Eastern Ghats (0.99–0.9 Ga), and Kuunga (0.53–0.49 Ga) orogens, are modified from Boger (2011) and Cawood et al. (2018). Af = Afghanistan, Ic = Indochina, H = Himalaya, Ir = Iran, L = Lhasa, S = Sibumasu, SQ = South Qiangtang, WB = West Borneo. Cam1/Cam2 = early/middle Cambrian, O3 = Late Ordovician, S23 = Middle–Late Silurian, D12 = Early–Middle Devonian, D3 = Late Devonian, C1 = Early Carboniferous, P1/P2 = Early/Late Permian. (d) Simplified Devonian–Early Carboniferous rock records and biotic provinces for the separation process between the SCB and neighboring blocks. Data sources: the time scale was created using TS Creator (<https://timescalecreator.org/index/index.php>; Ogg et al., 2016), the Loei Fold Belt was modified from Udchachon et al. (2017), JSJ-ALS-SM (Jinshajiang–Ailaoshan–Song Ma) from Jian et al. (2009) and Lai et al. (2014), the Youjiang Basin from Shi et al. (2006), the Inthanon Zone from Hara et al. (2010), and biotic provinces from Metcalfe (2013).

6. 中国南方石笋中的磁信号与冰期-间冰期旋回期间的古地貌重建



翻译人: 王浩森 502691781@qq.com

Chen Q, Zhang T W, Wang Y T, et al. Magnetism Signals in a Stalagmite From Southern China and Reconstruction of Paleorainfall During the Interglacial-Glacial Transition[J]. Geophysical Research Letters, 2019, 46.

摘要: 从稳定氧同位素中 ($\delta^{18}\text{O}$) 推断降水的变化一直争论不休。洞穴中的磁性通常认为与区域降水有关, 因此可以提供区域降水变化的可靠信息。本文展示了中国南方一个洞穴的石笋样品, 测量其磁信号, 并在 MIS5 期间重建了中国南方的区域降水。饱和磁化强度 (M_s) 能够代表磁性矿物浓度, 作为有效降雨量变化的指标。从 M_s 推断出的降水量在此前的 80.3 ka 之前急剧增加, 随后降水异常降低, 表明中国南方人类居住区间的区域降水变化很大。对 M_s 值的功率谱分析显示出显著的~205 年、~90 年、~77 年和~64 年的周期性, 表明太阳活动可能在 MIS5a/4 过渡期间中国南部的降水变化中起重要作用。

ABSTRACT: Precipitation variations deduced from speleothem stable oxygen isotopes ($\delta^{18}\text{O}$) have long been debated in monsoonal China. The magnetic property in speleothems is interpreted to be related to regional precipitation and can therefore offer reliable information of regional precipitation variations. Here we present a speleothem from southern China to explore the magnetic signals in speleothems and to reconstruct regional precipitation in hominin-occupational area in southern China during MIS5. Saturation magnetization (M_s), which represents the magnetic mineral concentrations, is used as an indicator of effective rainfall variations. The precipitation inferred from M_s increased sharply in the period prior to 80.3 ka before present, followed by a drop to precipitation anomaly afterward, indicating that regional precipitation varied greatly during the hominin-occupied interval in southern China. Power spectrum analysis of M_s values shows significant ~205-, ~90-, ~77-, and ~64-year periodicities, suggesting that the solar activity may play an important role in precipitation variations in southern China during the MIS5a/4 transition.

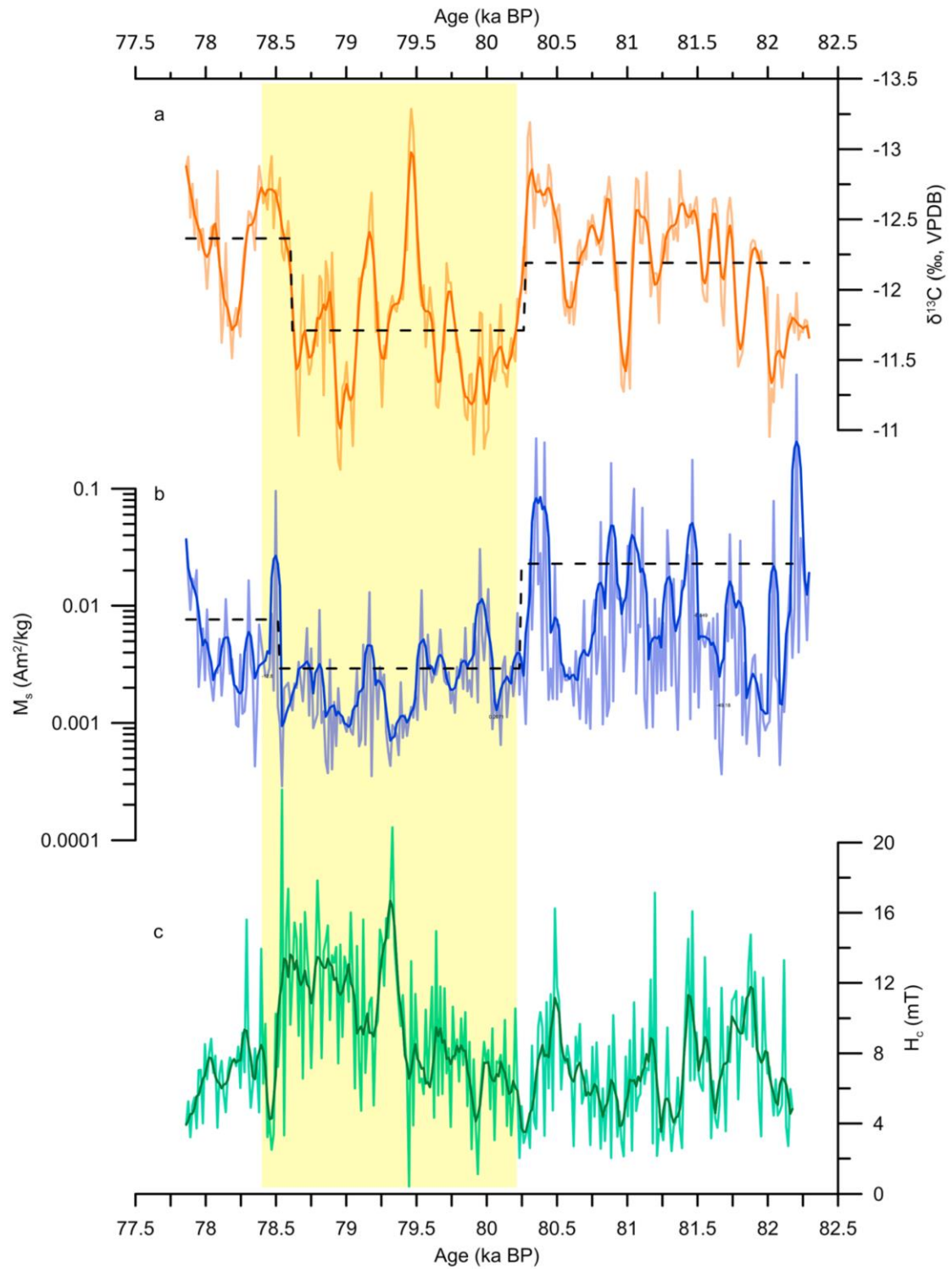


Figure 1. The comparison between saturation magnetization (M_s) and coercivity (H_c) and carbon isotopes ($\delta^{13}\text{C}$) in TN-1. The dashed lines denote the average values of M_s and $\delta^{13}\text{C}$, respectively. The yellow bar marks the relatively dryer period with higher H_c values.

7. 马里亚纳火山弧海山沉积物中细菌群落结构及新种类趋磁细菌研究



翻译人: 王敦繁 dunfan-w@foxmail.com

Liu J, Zhang W, Li X, et al. *Bacterial community structure and novel species of magnetotactic bacteria in sediments from a seamount in the Mariana volcanic arc[J]. Scientific Reports, 2017, 7(1):17964.*

摘要: 海山是海底隆升形成的陡峭的海底山脉, 底层水通过海山裂隙驱动元素进行动态循环。其独特的环境代表特有的生物栖息地并伴有多变的微生物群落结构。某些海山细菌形成明显的细胞外氧化铁结构, 包括结壳的茎、扁平的分叉管和丝状鞘。为了扩展我们对海山生态系统的认识, 我们对马里亚纳火山弧海山沉积物中能够在胞内矿化生成纳米级铁氧化物晶体的趋磁细菌(MTB)的种群结构和系统发育进行了综合研究。我们发现在 14 个站位中变形杆菌在 13 个站位为优势种, 但在马里亚纳-雅普海沟对面陡坡的深水站位中, 其数量次于厚壁菌门为第二优势种。另外, 在所有 14 个站位的生物沉积物中均有趋磁细菌分布, 深度从 238 米到 2023 米不等。而且我们还发现具有十分复杂鞭毛结构的趋磁球菌也有分布, 其 19 根鞭毛呈 3:4:5:4:3 的长度束状排列。通过对 16S rRNA 基因序列的系统发育分析, 我们鉴定出该海山沉积物中 16 个趋磁细菌新种。综合分析结果表明, 海山的地理特征对细菌群落结构和趋磁细菌的分布具有十分重要的影响。

ABSTRACT: Seamounts are undersea mountains rising abruptly from the sea floor and interacting dynamically with underwater currents. They represent unique biological habitats with various microbial community structures. Certain seamount bacteria form conspicuous extracellular iron oxide structures, including encrusted stalks, flattened bifurcating tubes, and filamentous sheaths. To extend our knowledge of seamount ecosystems, we performed an integrated study on population structure and the occurrence of magnetotactic bacteria (MTB) that synthesize intracellular iron oxide nanocrystals in sediments of a seamount in the Mariana volcanic arc. We found Proteobacteria dominant at 13 of 14 stations, but ranked second in abundance to members of the phylum Firmicutes at the deep-water station located on a steep slope facing the Mariana-Yap Trench. Live MTB dwell in biogenic sediments from all 14 stations ranging in depth from 238 to 2,023 m. Some magnetotactic cocci possess the most complex flagellar apparatus yet reported; 19 flagella are

arranged in a 3:4:5:4:3 array within a flagellar bundle. Phylogenetic analysis of 16S rRNA gene sequences identified 16 novel species of MTB specific to this seamount. Together the results obtained indicate that geographic properties of the seamount stations are important in shaping the bacterial community structure and the MTB composition.

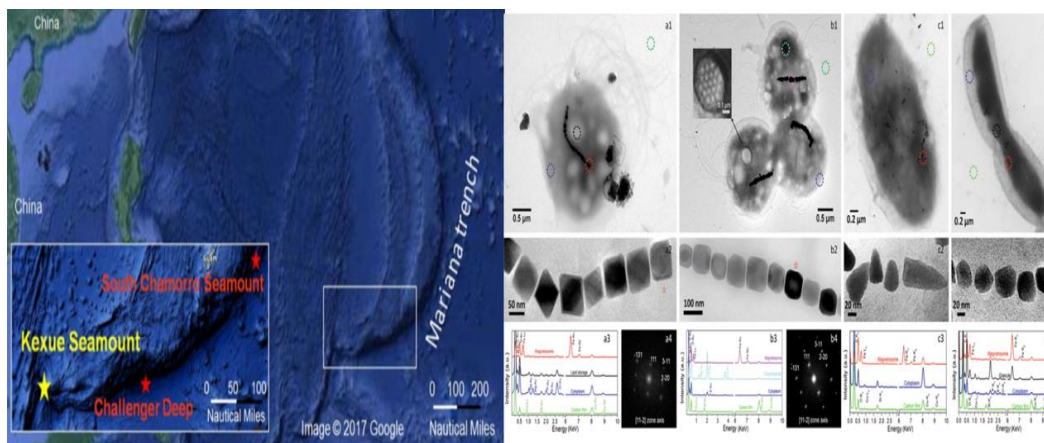


Figure 1. Location of the Kexue seamount (yellow stars) is shown in the insert. The South Chamorro seamount and Challenger Deep are indicated with red stars. The map data was from Imagery ©2017 Data SIO, NOAA, U.S. Navy, NGA, GEBCO, Map data ©2017 Google, ZENRIN downloaded at <https://www.google.fr/maps/@11.7463718,145.5037996,1320412m/data=!3m1!1e3>. The fourteen ROV sampling stations at the Kexue seamount are indicated with white circles and their unique station code. Panel (right). Seamount MTB and identification of the magnetic crystals. Panels a1 and b1: Magnetotactic cocci having single chains of octahedral and prismatic magnetite magnetosomes. Panel c1 and d1: Vibrioid MTB and dumbbell-shaped MTB. Panels a2, b2, c2 and d2: Magnified images of magnetosomes. Coloured circles indicate analysis points for the EDXS analyses shown in a3, b3, c3 and d3. Electron diffraction images of the red star magnetosomes are shown in a4 and b4. The inset in b1 shows a flagella base platform comprising 19 individual flagella that are arranged in a 3:4:5:4:3 array (left).

8. 通过大塔穆火山 (Tamu Massif) 的磁异常分析海底扩张形成的洋底高原



翻译人: 曹伟 11930854@mail.sustech.edu.cn

William W S, Yanming H, Masako T, et al. Oceanic plateau formation by seafloor spreading implied by Tamu Massif magnetic anomalies[J]. Nature Geoscience, 2019, 12:661-666

摘要: 大塔穆火山 (Tamu Massif) 是一座巨大的中生代海底火山, 是沙茨基海隆高原 (Shatsky Rise oceanic plateau) 的主要组成部分。它位于一个扩张的洋中脊三联点处, 但被认为是一个由新兴地幔柱的火山喷发所形成的盾形火山。然而目前尚不清楚大塔穆火山喷发与扩张脊 (巨大的线型火山) 之间的相互作用, 所以我们绘制了大塔穆火山区域的磁异常图, 为地壳的形成提供线索。在大塔穆火山区, 我们发现主要的线型磁异常是由磁极相反的地壳块体所引起的。这种模式表明大塔穆火山不是一个盾形火山, 而是由大量集中的脊状火山侵位所形成的。如果沙茨基隆起处的岩浆源是一个热柱, 那么它与海底扩张密切相关, 并受到海底扩张的控制。这就意味着即使是最大的洋底高原也可以由海底扩张形成。我们认为, 广泛被接受的大陆溢流玄武岩与洋底高原之间的类比需要重新进行考虑。

ABSTRACT: Tamu Massif is an immense Mesozoic submarine volcano, the main edifice of the Shatsky Rise oceanic plateau. It is located at a spreading ridge triple junction, but considered to be a shield volcano formed by effusive volcanism from an emerging mantle plume. However, it is unclear how Tamu Massif eruptions interacted with the spreading ridges, which are enormous linear volcanoes themselves. Here we create a magnetic anomaly map for Tamu Massif, which can provide clues about crustal formation. For Tamu Massif, we find dominantly linear magnetic field anomalies caused by crustal blocks of opposite magnetic polarity. This pattern suggests that Tamu Massif is not a shield volcano, but was emplaced by voluminous, focused ridge volcanism. If the magma source at the Shatsky Rise was a plume, it was closely connected to and controlled by seafloor spreading. By implication, even the largest oceanic plateau edifices can be formed by seafloor spreading. We suggest that the widely accepted analogy between continental flood basalts and oceanic plateaus requires reconsideration.

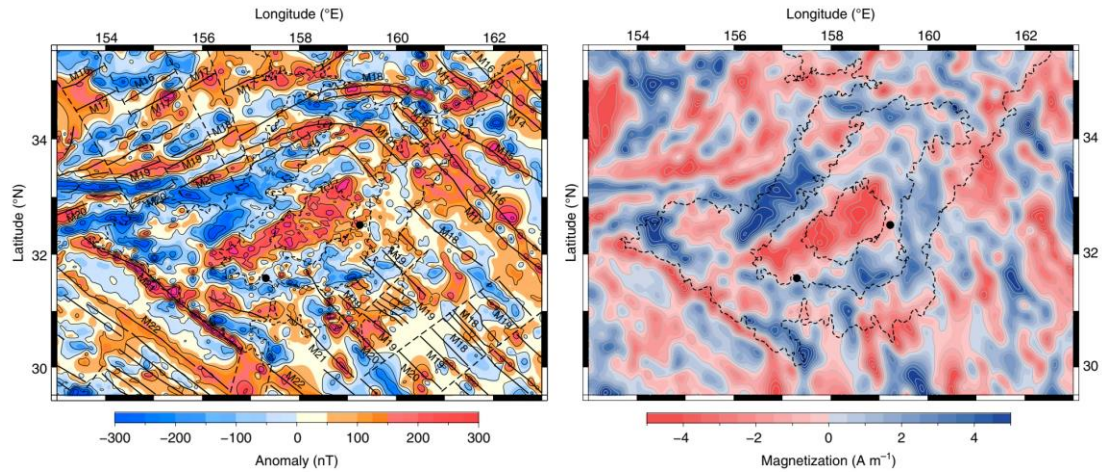


Figure 1. Left, previously defined magnetic anomalies are overlaid on a magnetic anomaly map created in this study. Right, the magnetization model was derived from Fourier inversion. As negative magnetizations cause positive magnetic anomalies (and vice versa), negative magnetizations are plotted in warm colours to emphasize the correlation with positive magnetic anomalies. The dashed lines show simplified Tamu Massif bathymetry contours (at 5, 4 and 3 km depth), and black dots denote drill sites 1213 and U1347.

9. 中国东南地区降水同位素比值的日际至年际变化的区域控制:

古季风重建的启示



翻译人: 郑威 11930589@mail.sustech.edu.cn

Ruan J, Zhang H, Cai Z, et al. *Regional controls on daily to interannual variations of precipitation isotope ratios in Southeast China: Implications for paleomonsoon reconstruction*[J]. *Earth and Planetary Science Letters*, 2019, 527: 115794.

摘要: 尽管许多东亚地区关键的古季风记录依赖与古降水氧同位素比值 ($\delta^{18}\text{O}_p$) 作为研究古气候的代用指标, 但 $\delta^{18}\text{O}_p$ 与气候变化的关系仍然存在许多争议, 本文基于广州 8 年的日 $\delta^{18}\text{O}_p$ 记录和更新的香港 GNIP 数据库, 研究了主要气候驱动因子以及检验早前讨论过的一些关于中国东南部 $\delta^{18}\text{O}_p$ 在各种时间尺度下的变化。水汽源分析结果指示广州的降水主要源区为临近的南海 (SCS) 北部地区 (根据沿后向轨迹的累积降水测量), 区域降水, 以及外向长波辐射对 $\delta^{18}\text{O}_p$ 在多尺度下的规律变化起主导作用。这些影响与 SCS 对流强度的直接变化或与源区移动有关的非直接变化有关。因此, $\delta^{18}\text{O}_p$ 记录了热带辐合带移动以及受南方涛动 (ENSO) 影响的季节性季风动力。通过 2015 年强厄尔尼诺事件对不同假说的进一步检验以及它们与 ENSO 的联系支持了上述结论。综上, 这些结论证明了中国东南部 $\delta^{18}\text{O}_p$ 代表一种从监测站到水汽源轨迹上的时空综合降水、对流测量, 阐明了季风区的古同位素数据的解释。

ABSTRACT: Many key paleomonsoon records in East Asia rely on past precipitation isotope ratios ($\delta^{18}\text{O}_p$) as proxies for hydroclimate, however, the relationship between climate variability and $\delta^{18}\text{O}_p$ remains an ongoing debate. Here we investigate dominant climatic drivers and test actively-discussed hypotheses of Southeast China $\delta^{18}\text{O}_p$ variability over multiple timescales, using an 8-yr-long daily $\delta^{18}\text{O}_p$ record from Guangzhou and updated GNIP dataset from Hong Kong. Our moisture source diagnostic analyses suggest that the primary moisture of Guangzhou precipitation essentially comes from the proximal northern South China Sea (SCS). Convective activities over the primary moisture source regions, measured by cumulative precipitation along back-trajectory, regional precipitation and outgoing longwave radiation, play a key role in regulating $\delta^{18}\text{O}_p$ variability across different timescales. These effects can be related to the direct changes of convection intensity over

the SCS or the indirect changes associated with the shift of moisture source. In consequence, $\delta^{18}\text{O}_p$ records seasonal monsoon dynamics associated with the intertropical convergence zone migration and the El Niño-Southern Oscillation (ENSO). Further tests of different hypotheses and their links to the ENSO via the 2015 strong El Niño event support the above conclusions. Taken together, these results demonstrate that Southeast China $\delta^{18}\text{O}_p$ represents a spatial-temporally integrated measure of precipitation and convection tracing from the measured site to moisture sources, shedding light on the interpretation of paleo-isotope data in the monsoon domain.

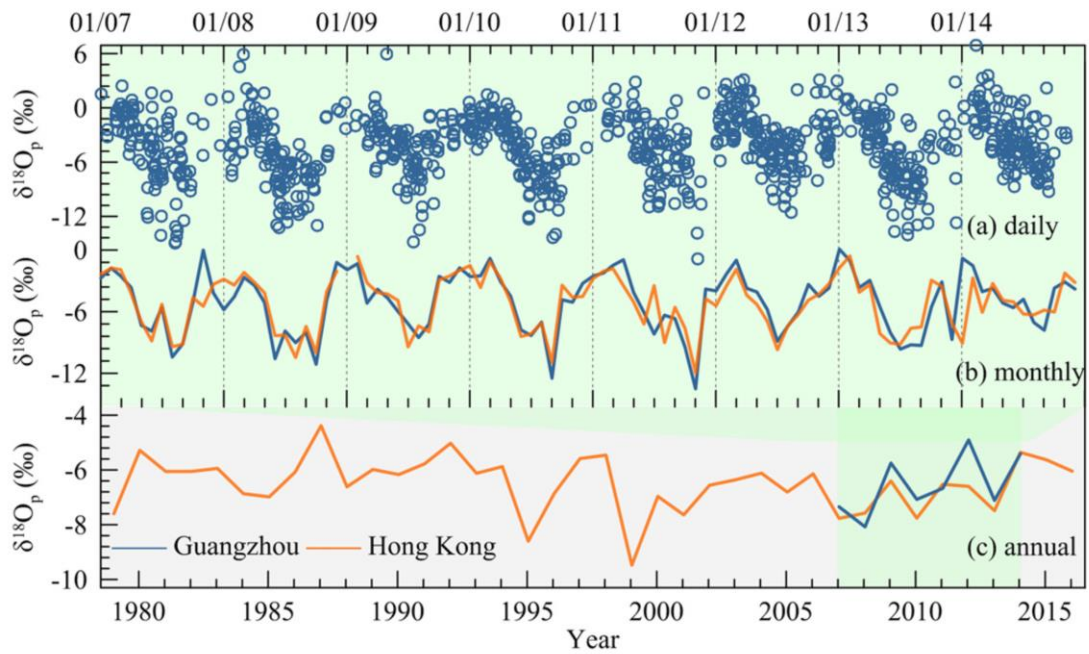


Figure 1. The $\delta^{18}\text{O}_p$ variations of Guangzhou and Hong Kong on daily (a), monthly (b), and annual (c) timescales. Note that the upper x-axis is related to (a) and (b) panels while the lower x-axis is related to (c) panel.

10. 过去 850,000 年以来气候与亚北极太平洋营养盐上涌的协同变化



翻译人：陈艇 chent6@sustech.edu.cn

Worne S, Kender S, Swann G E A, et al. *Coupled climate and subarctic Pacific nutrient upwelling over the last 850,000 years*[J]. *Earth and Planetary Science Letters*, 2019, 522: 87-97.

摘要：在冰期尺度上，高纬度深层水上涌可以通过生物泵以及 CO₂ 在海洋-大气之间的交换控制全球气候变化。然而，目前尚缺乏连续的长时间尺度的营养盐上涌的记录。本文研究了白令海过去 850kyr 以来营养盐上涌变化的地球化学记录以及冰期北太平洋中层水(GNPIW)的形成。结果表明，冰期时营养盐上涌减弱，与全球大气 CO₂ 浓度和温度的降低对应。我们认为冰期白令海地区海冰以及以低营养盐为特征的 GNPIW 的扩张阻碍了整个亚北极太平洋地区的垂直混合和营养盐的供应。本文的结果支持了如下的观点：在冰期-间冰期尺度上，高纬度海冰以及中层水的形成调控着深层水上涌和 CO₂ 在大气-海洋之间的交换。

ABSTRACT: High latitude deep water upwelling has the potential to control global climate over glacial timescales through the biological pump and ocean-atmosphere CO₂ exchange. However, there is currently a lack of continuous long nutrient upwelling records with which to assess this mechanism. Here we present geochemical proxy records for nutrient upwelling and glacial North Pacific Intermediate Water (GNPIW) formation in the Bering Sea over the past 850 kyr, which demonstrates that glacial periods were characterised by reduced nutrient upwelling, when global atmospheric CO₂ and temperature were also lowered. We suggest that glacial expansion of sea ice in the Bering Sea, and the simultaneous expansion of low nutrient GNPIW, inhibited vertical mixing and nutrient supply across the subarctic Pacific Ocean. Our findings lend support to the suggestion that high latitude sea ice and the resultant intermediate water formation, modulated deep water upwelling and ocean-atmosphere CO₂ exchange on glacial-interglacial timescales.

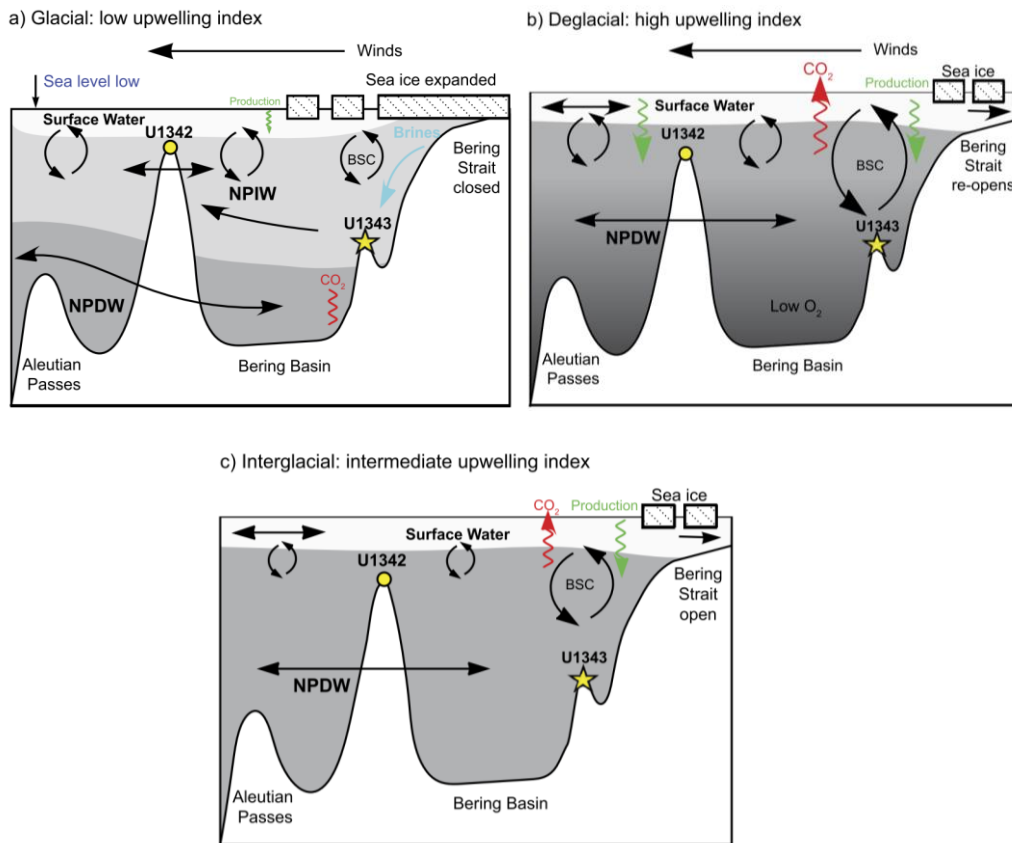


Figure 1. Schematic models representing glacial, deglacial and interglacial regimes of biogeochemical cycling in the Bering Sea. a) A low upwelling index indicates reduced upwelling caused by an expansion of NPIW which forms in glacials following the closure of the Bering Strait, leading to an isolated pool of nutrients in the photic zone. This results in reduced primary productivity (opal MAR) but higher rates of nutrient utilisation due to the reduced supply of deep water nutrients into the photic zone. b) A high upwelling index indicates ample nutrient supply from resumed NPDW upwelling which occurs during deglaciation, leading to a high productivity/low nutrient utilisation state. c) An intermediate upwelling index results indicates upwelling typical of an interglacial, similar to the modern regime.