

8/11/2022

涪陵区

2011/12

齐岳山断裂

奉节县

巫山县

瞿塘峡，西起重庆市奉节县的白帝城，东至巫山县的大溪镇，全长仅约8公里。



巫峡，西起重庆市巫山县城东面的大宁河口，东至巴东县官渡口，全长46公里。



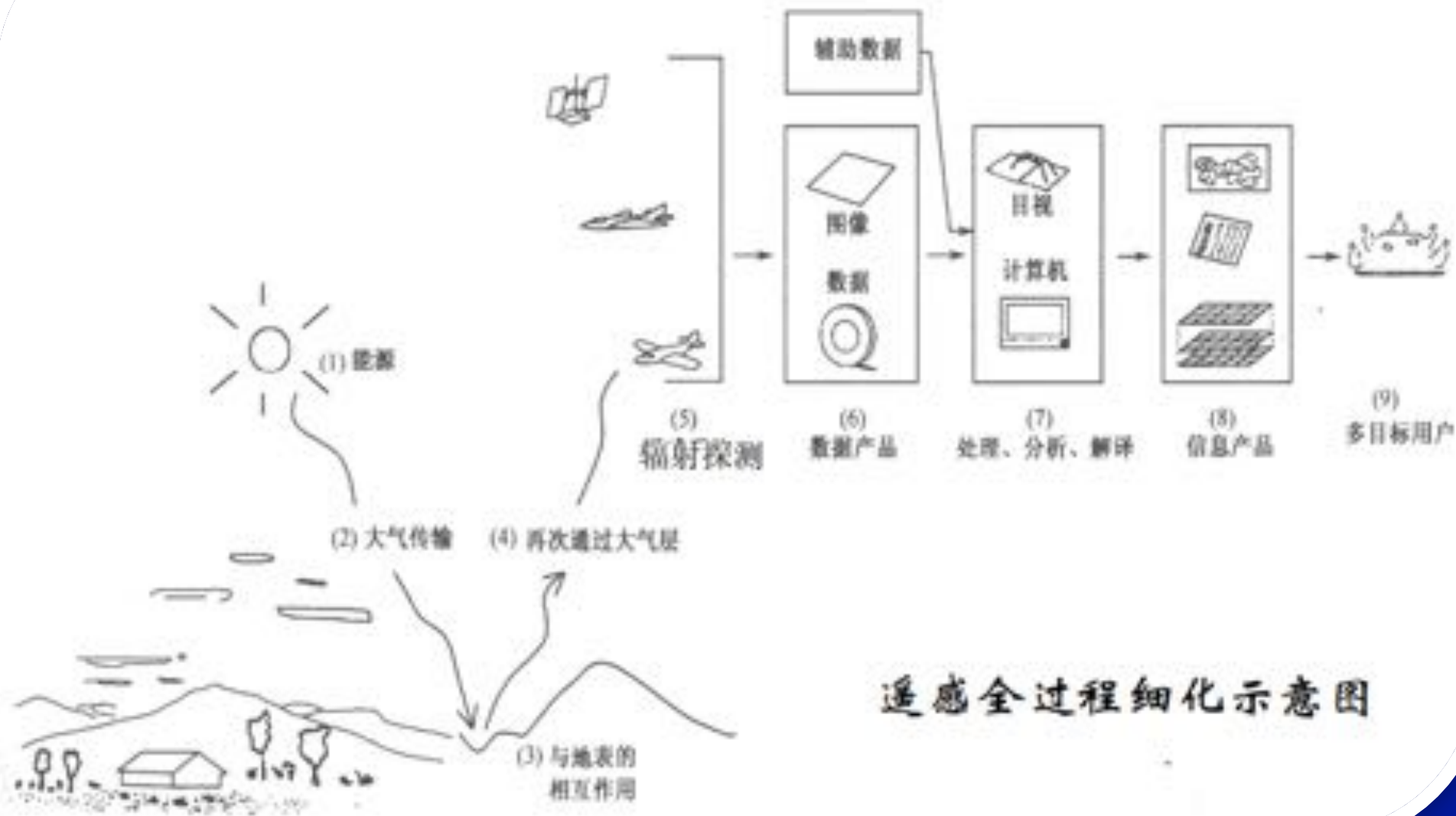
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西陵峡，西起秭归县香溪口，东止宜昌市南津关，全长约76公里，以险峻闻名于世。“西陵山水天下佳”。

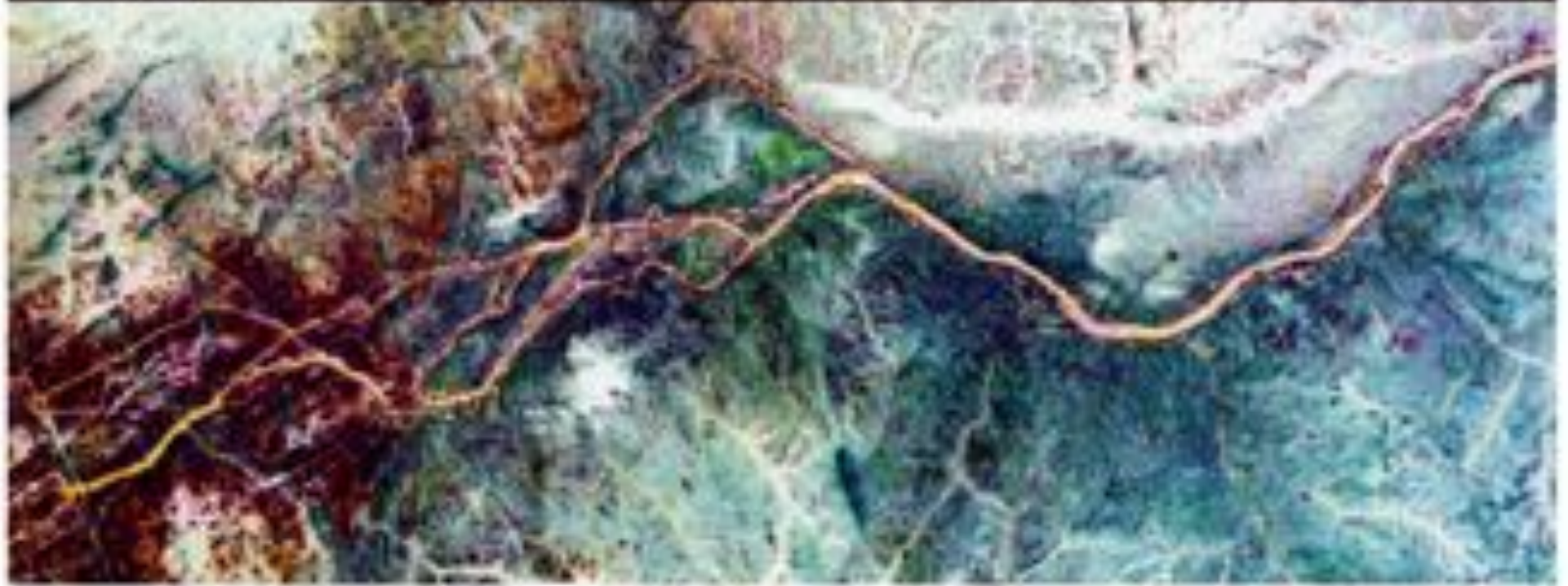
数据获取

数据处理、分析

数据应用



遥感全过程细化示意图



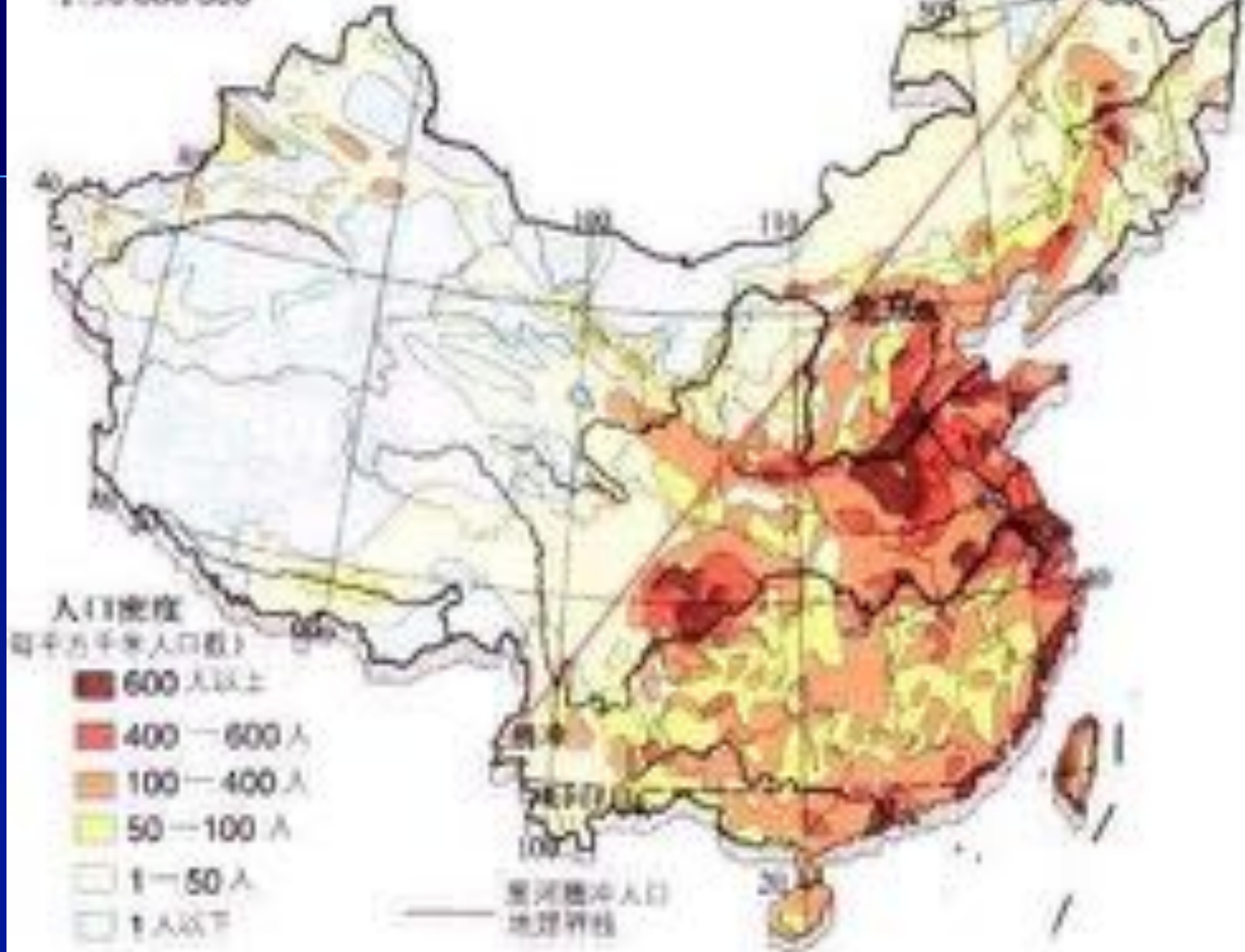
遥感作为一种新型的对地观测系统，它的出现对地球科学各分支的推动是巨大的，遥感是多学科的综合，具有很强的“交叉性”。

它既需要认识电磁波的基本原理，又需要熟悉地球科学及相关学科(空间科学、信息科学、生命科学等)的内容，还融合了数学、计算机科学等多种学科的知识。



中国人口密度

1:50 000 000



胡焕庸线以东地区以43.71%的国土面积养育了94.39%的人口。

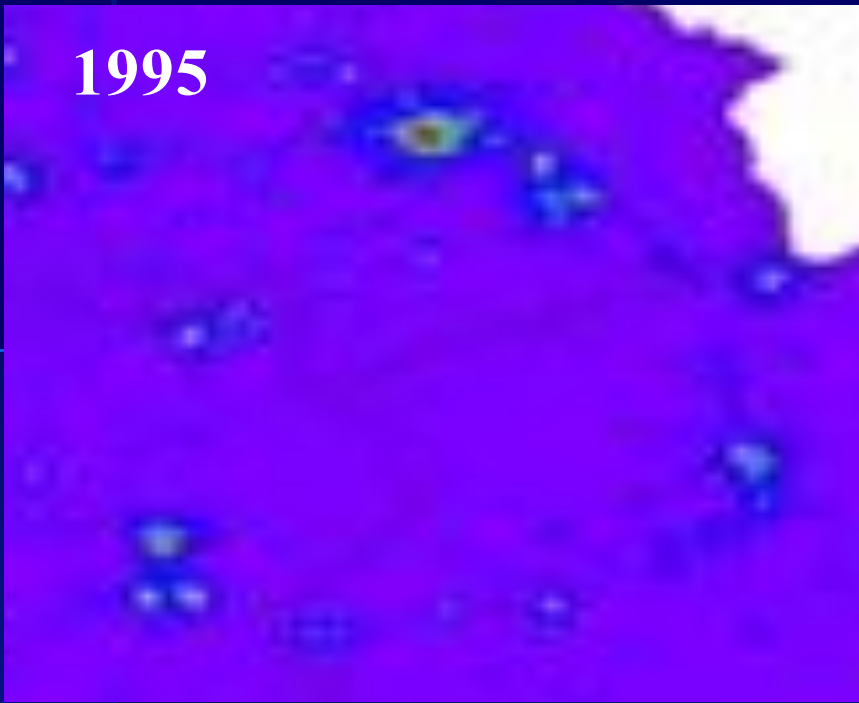
李克强发出了“胡焕庸线怎么破”之问：“我国94%的人口居住在东部43%的土地上，但中西部一样也需要城镇化。”



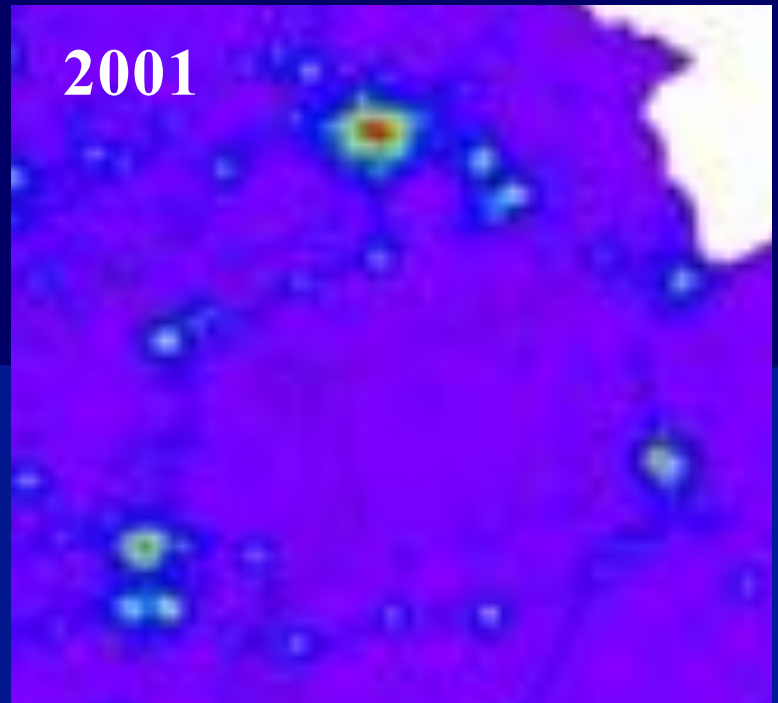




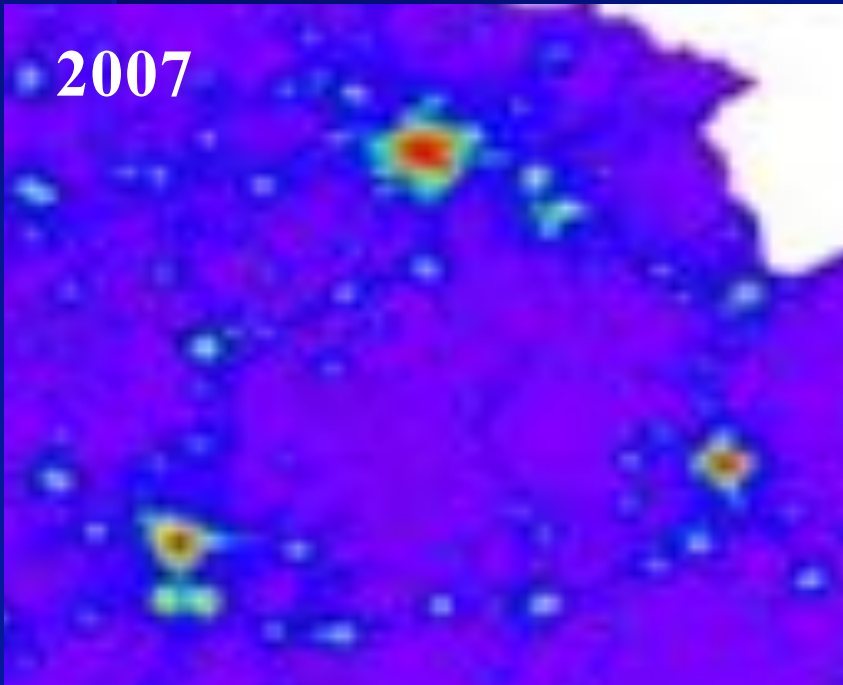
1995



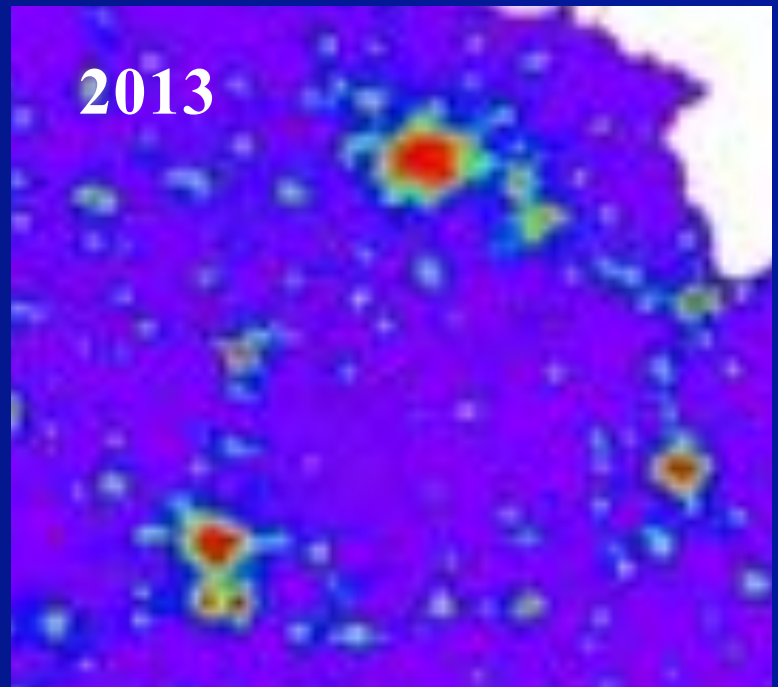
2001



2007

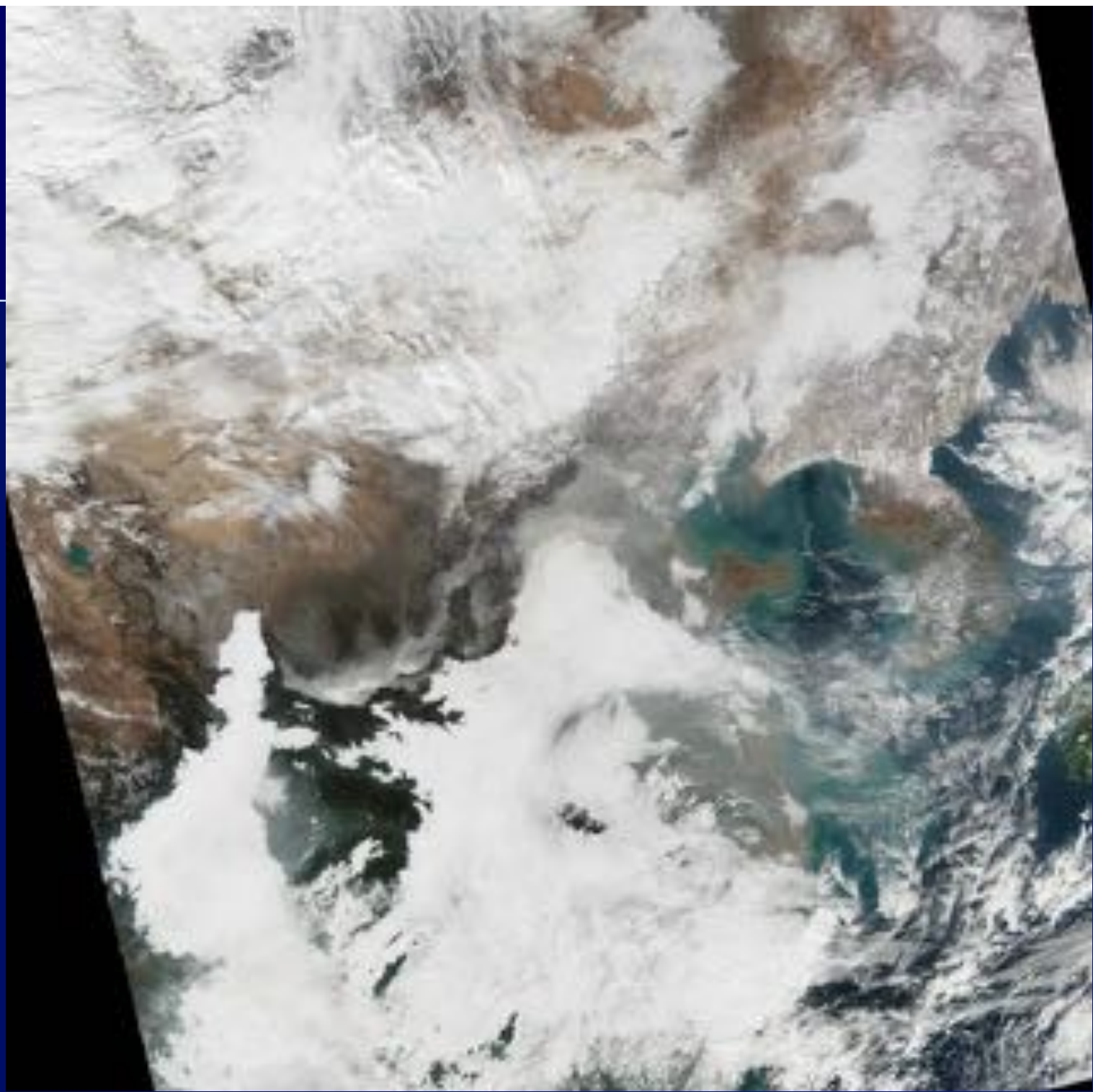


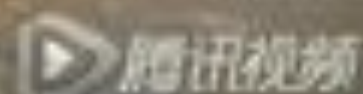
2013











中国制造
"MADE IN CHINA"

北京
BEIJING



这是一幅中国东北部的卫星图像
This is a satellite image of northeastern China.



新明里

新明里

新明里

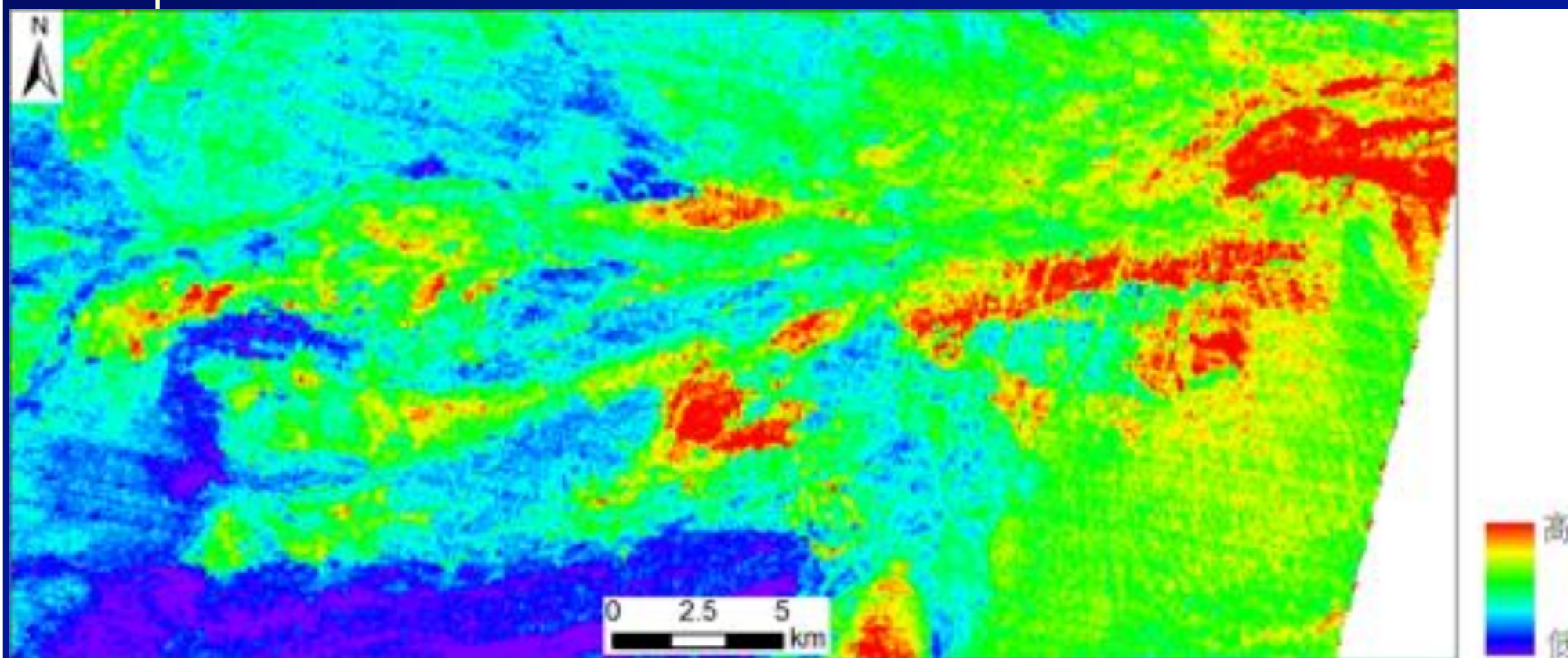


乾为天，坤为地、震为雷、巽(xùn)为风，坎为水，艮(gèn)为山、离为火、兑为泽

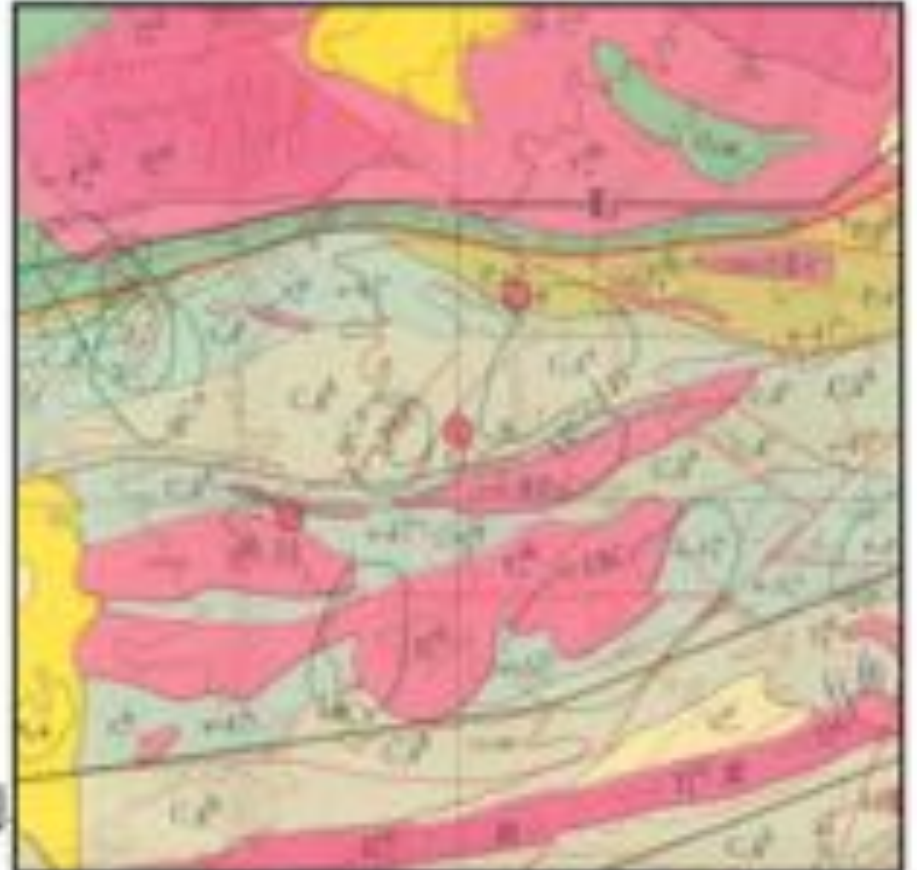
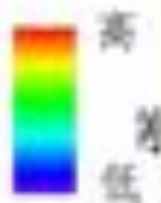
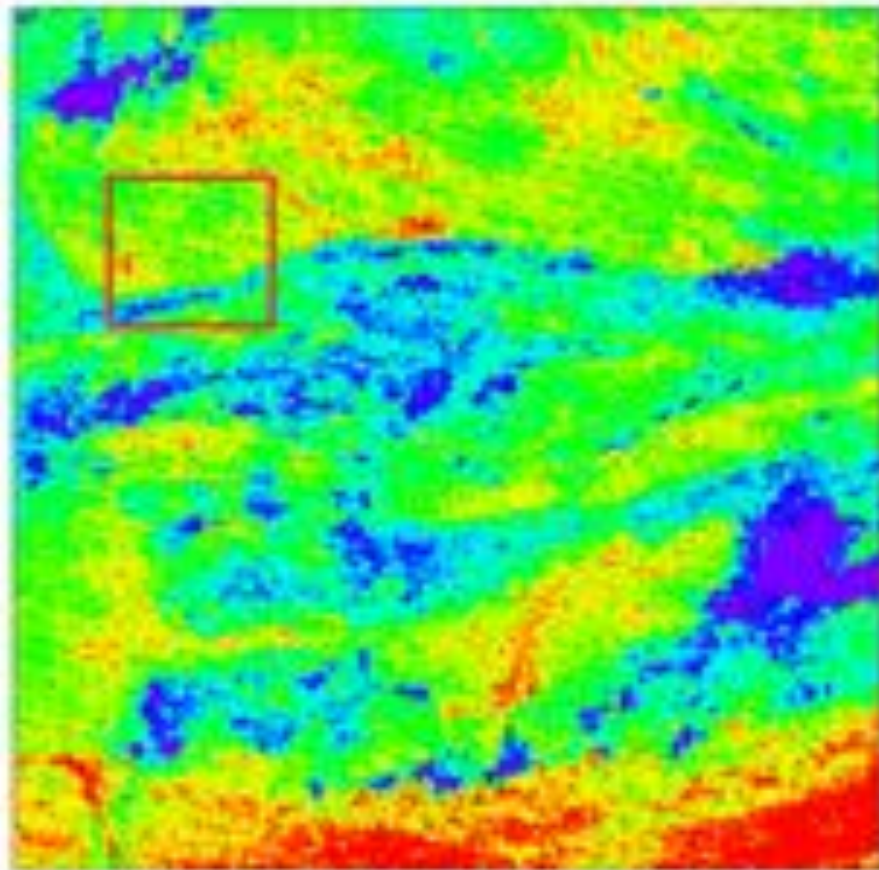


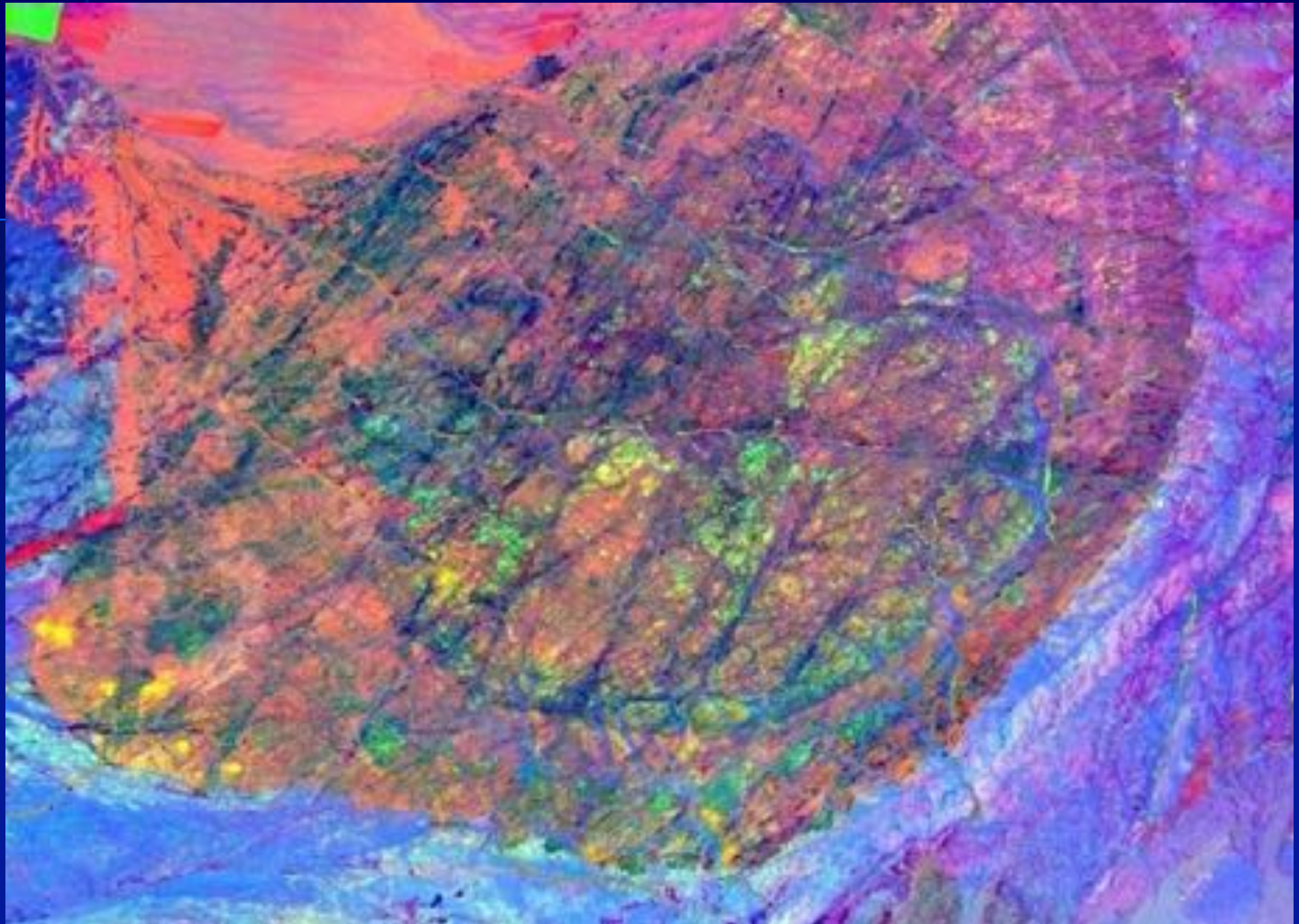


基于ASTER SWIR的MgO反演模型提取基性-超基性岩



基于ASTER TIR的酸性岩漿岩SiO₂反演模型







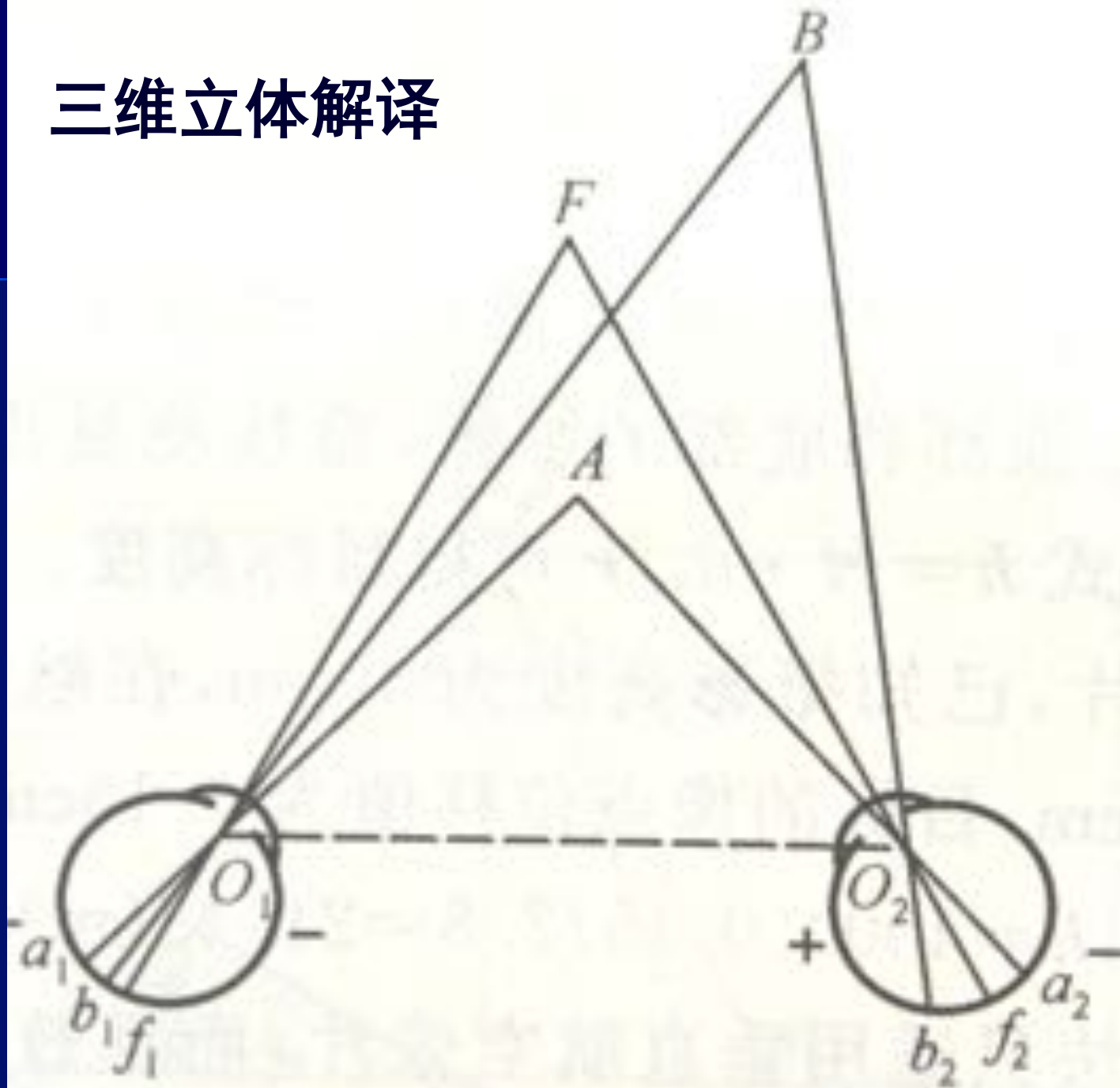




马是被捕食的动物，它的两只眼睛长在头的两侧，看东西立体感很差，虽然其视野可以达到 330° ，但马的两眼视线重叠的部分只有 30° 。因此，马会被同一事物惊吓两次。

捕猎动物，两只眼睛都长在前面，两只眼睛的视野重叠，帮助大脑判断物体的远近，为物体的准确定位带来很大帮助。

三维立体解译



遥感是人的感知器官（眼）视觉分析功能的延长

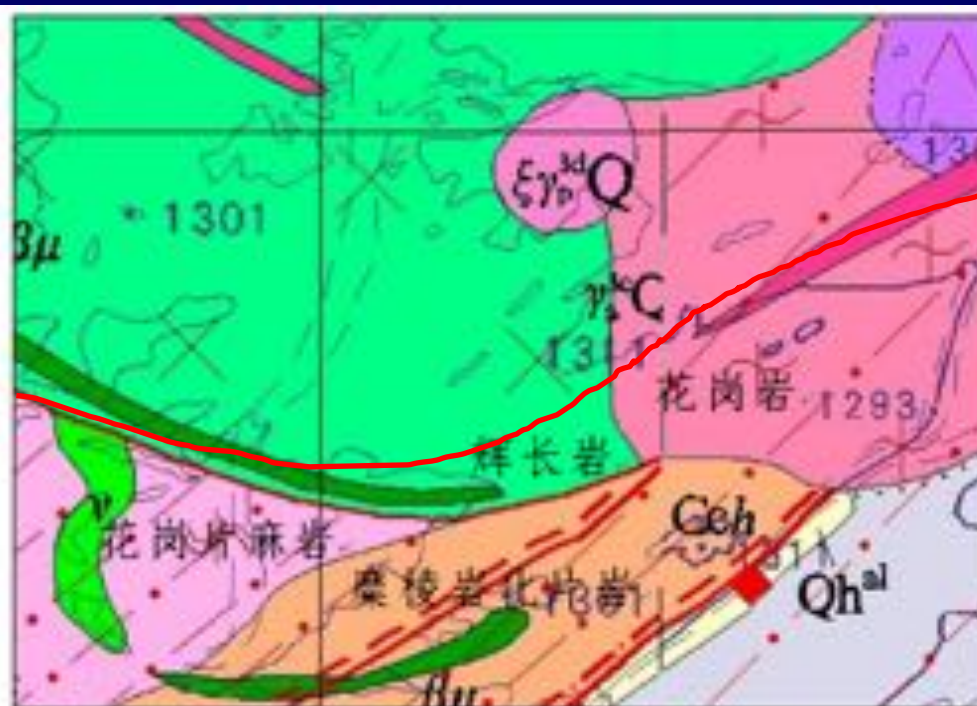
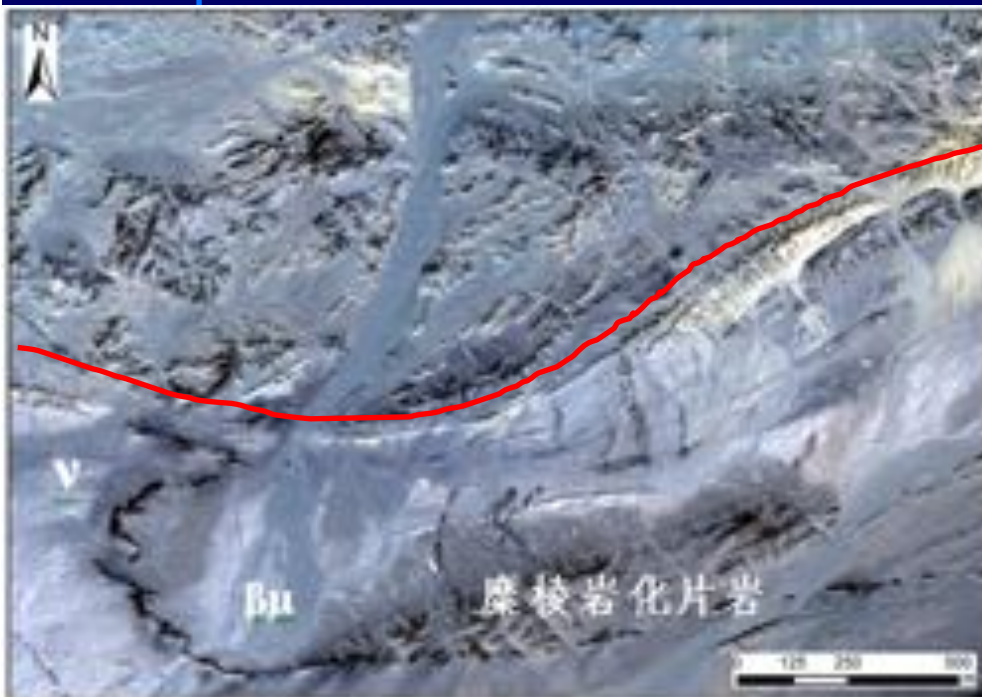
- **观察距离的扩展**：数百—数千公里以至更远；
- **电磁波范围的扩展**：所有电磁波段，但主要为可见光、红外、微波；
- **观察方式的扩展**：主动方式和被动方式，地面观察和太空观察，瞬时观察和连续观察；
- **认知方式的扩展**：生物认知和数据分析。

遥感

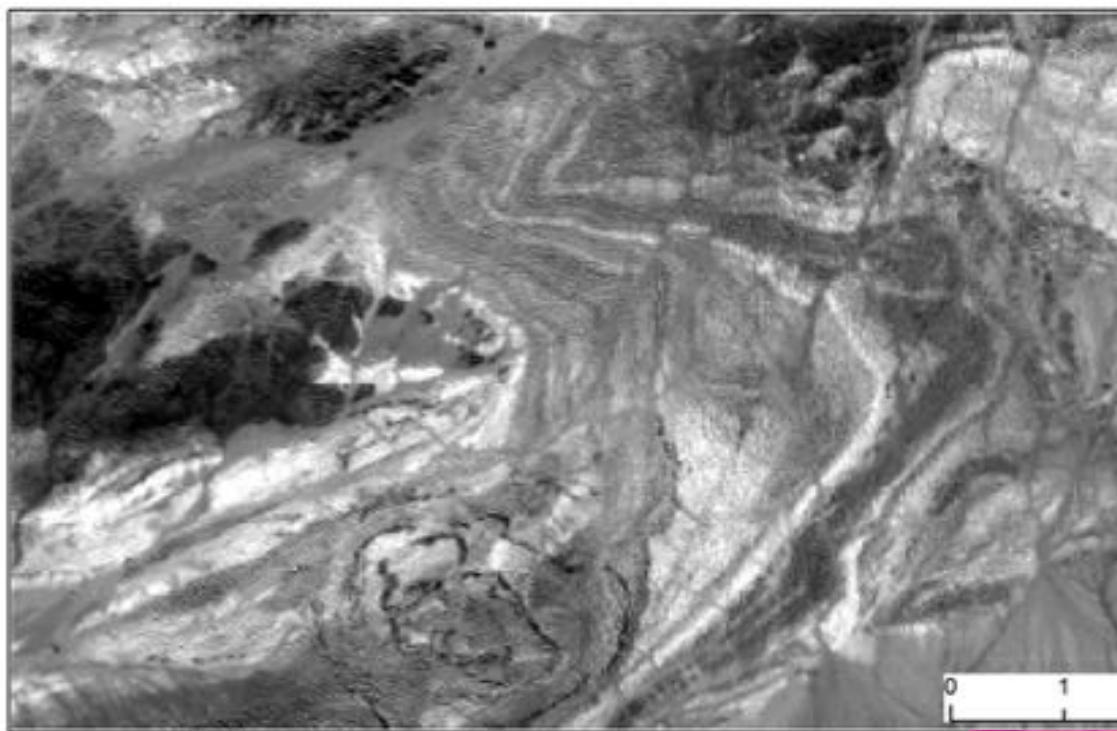
可克服现场调查中地形、交通、气候等不利的影响。

显著提高早期识别的准确率和评价精度。

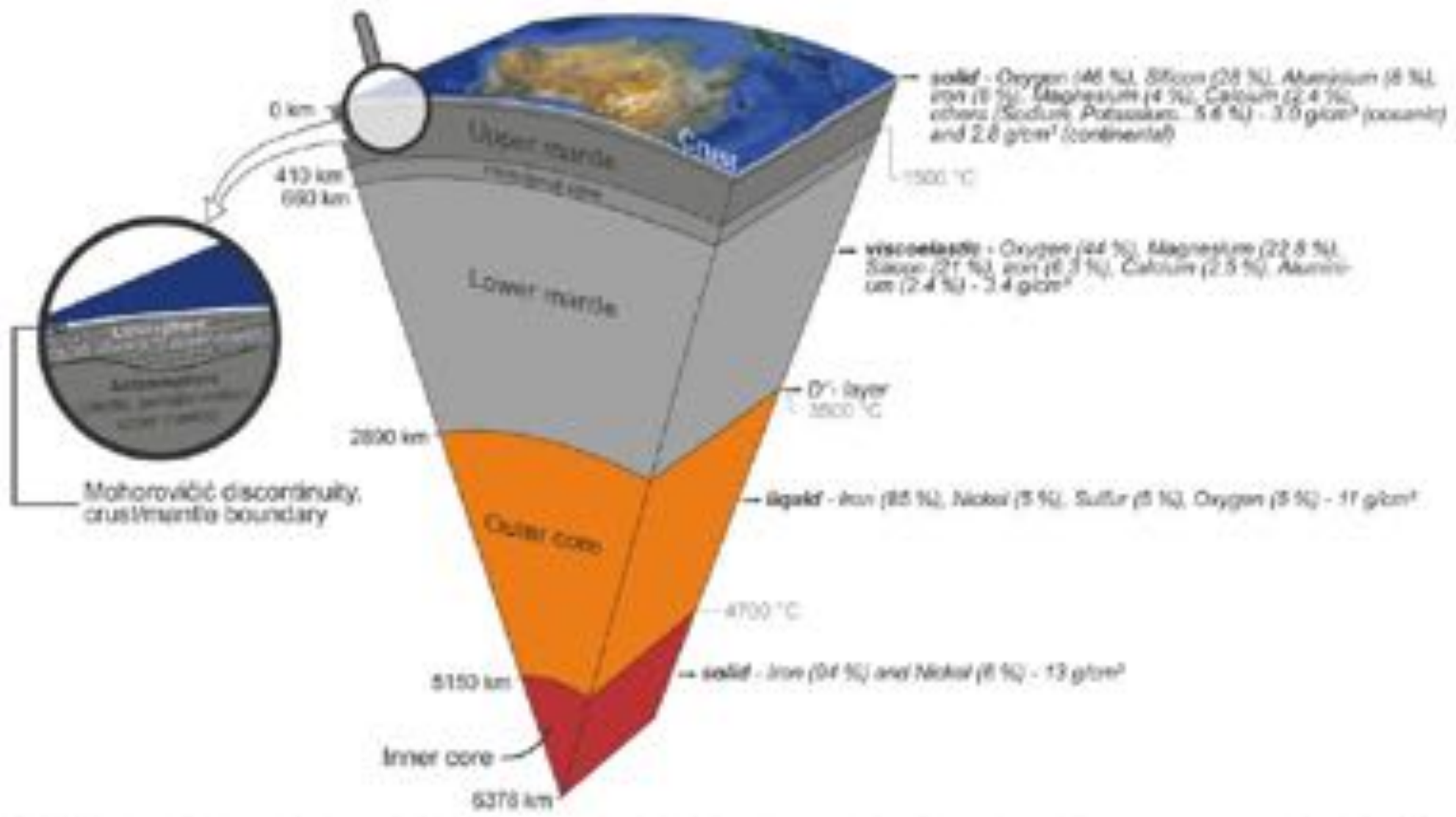
遥感信息的连续性信息可以弥补离散观察的不足。

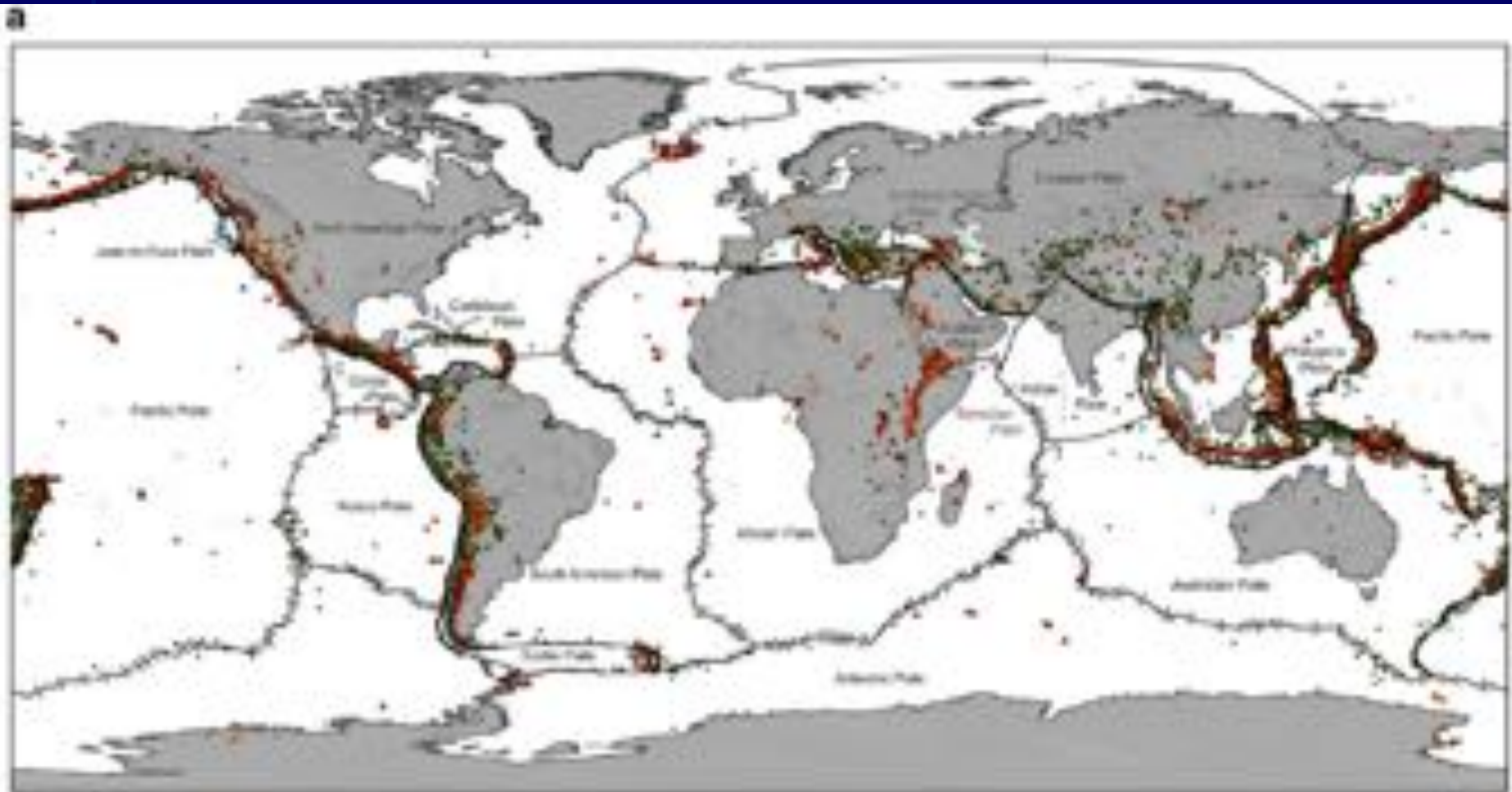


1. 连续的一条岩脉被划分为辉长岩脉与灰绿玢岩脉；
2. 一条弧形断层只表达了西部的一段；
3. 一条北东向展布的地质体被人为的分别划为寒武纪灰色中粒花岗岩片麻岩、志留纪土黄色似片麻状中粒花岗岩；

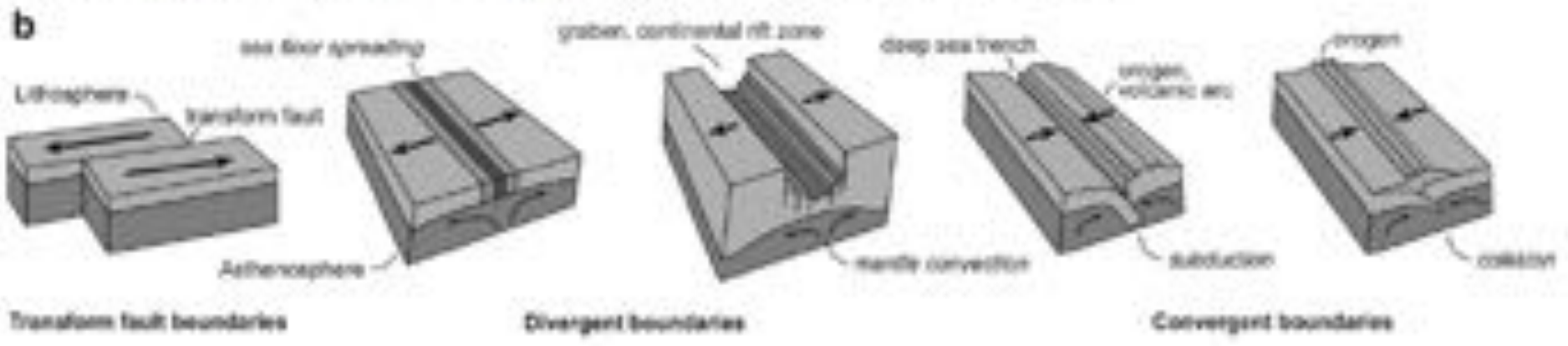


地貌形成过程及动力学





Δ subglacial volcano ▲ volcanic volcano ▲ active volcano ▲ dormant, potentially active volcano (e.g., Iceland activity) ● earthquakes
 ← divergent plate boundary (sea-floor spreading) → convergent plate boundary (subduction, collision) — other plate boundary (transform fault)



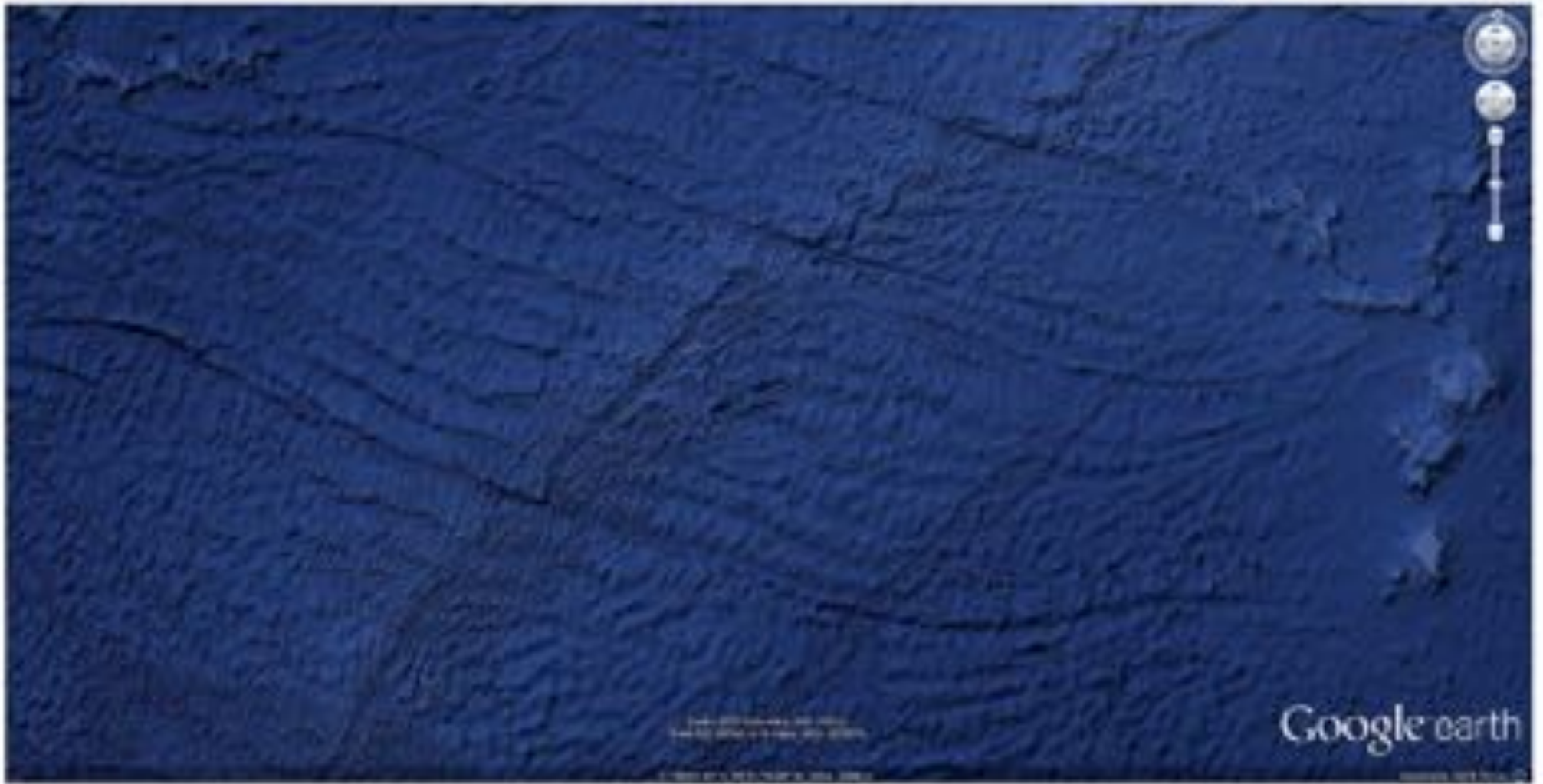


42.5 公里

Image ID: 101
Image © 2015 Google
Image © 2015 Google

Google earth

影像拍攝日期: 2015-12-14 59° 42' 00.12" 北 21° 30' 34.36" 西 海拔: -2542 米 視角海拔高度: 2839.35 公里



a



b





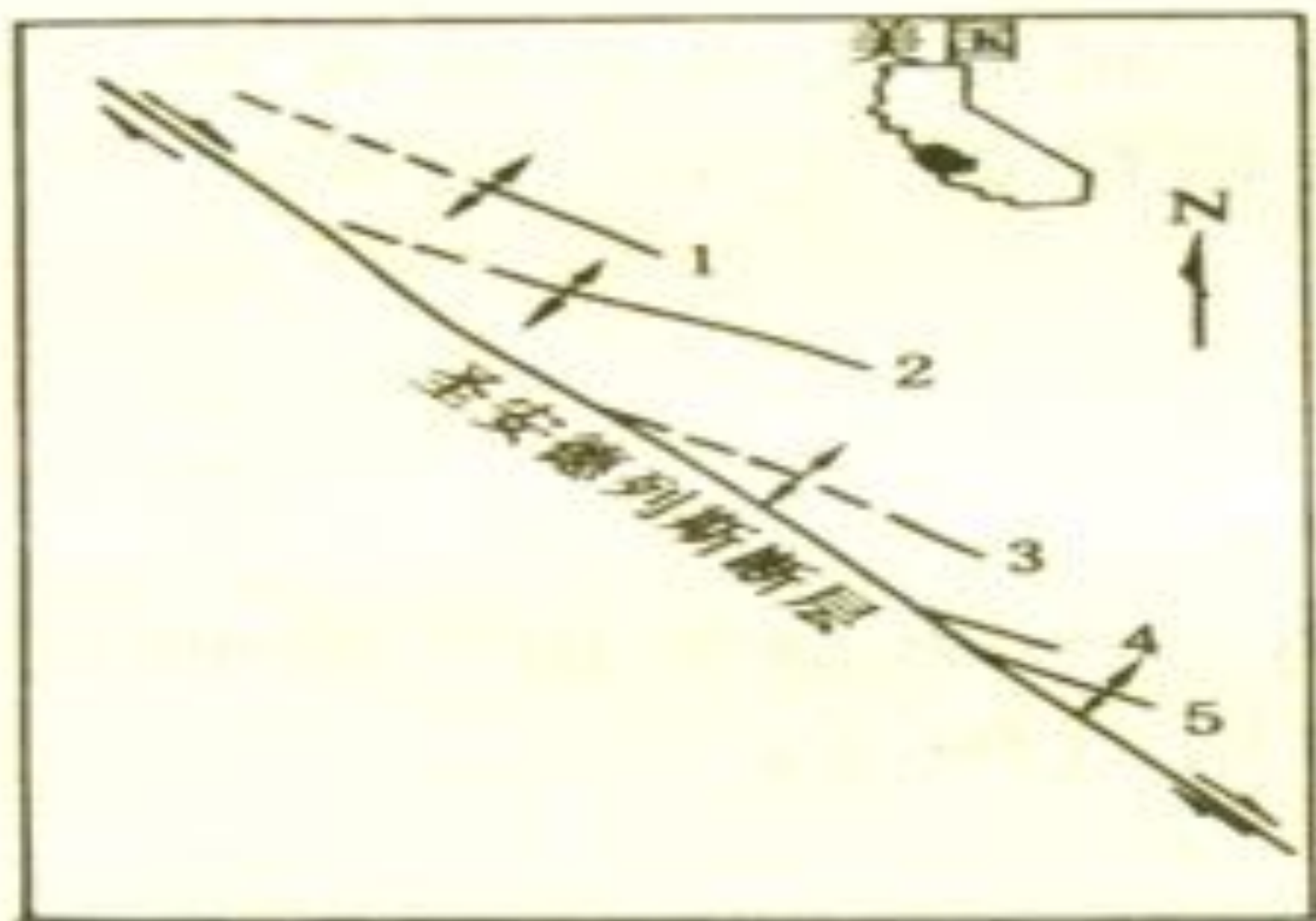
Image taken on Nov. 14, 2007
Image taken at 11:07:00 AM

影像拍攝日期: 2007/11/14 16° 44' 26.32" 北 45° 24' 20.26" 东 海拔: 1297 米 視角海拔高度: 3280.70 公里



c





圣安德列斯断层一侧的雁列式褶皱
(据 Moody 等, 1956)





Handmade by Google
© 2005 Google

Google earth

25° 53' 37.17" 北 102° 59' 20.00" 东 海拔: 2422 米 视角海拔高度: 1048.61 公里



火山地貌



Data: NOAA, U.S. Navy, NOAA, IBCAO
Images: Landsat / Copernicus
Image: IBCAO

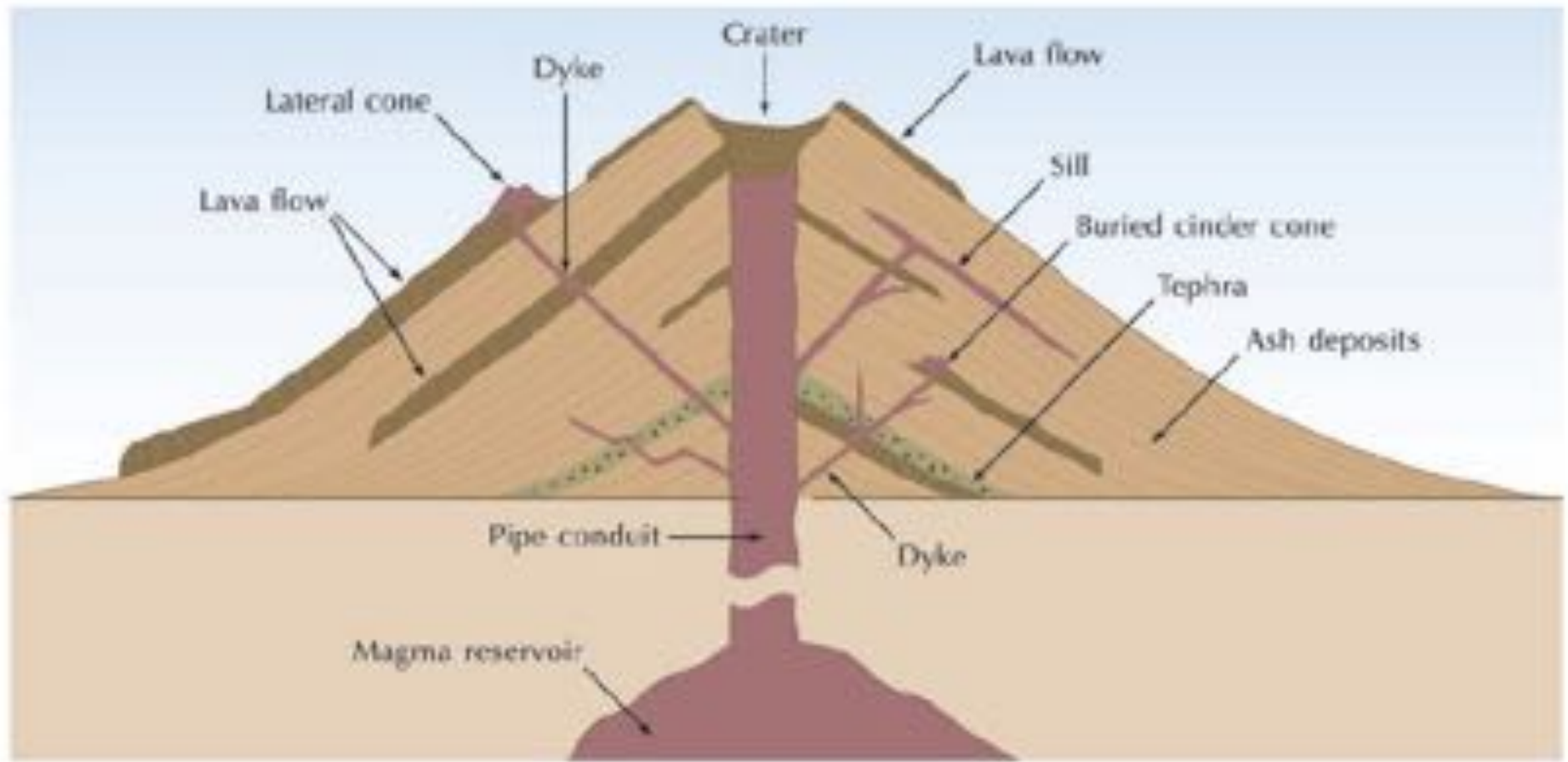






Plate 6.4 Novarupta rhyolite tholoid formed in 1912 in the Katmai caldera, Katmai National Park, Alaska USA. (Photograph by Tony Waltham Geophotos)





Kauai
18-5.6

Oahu
2.2-3.3

Molokai
1.3-1.8

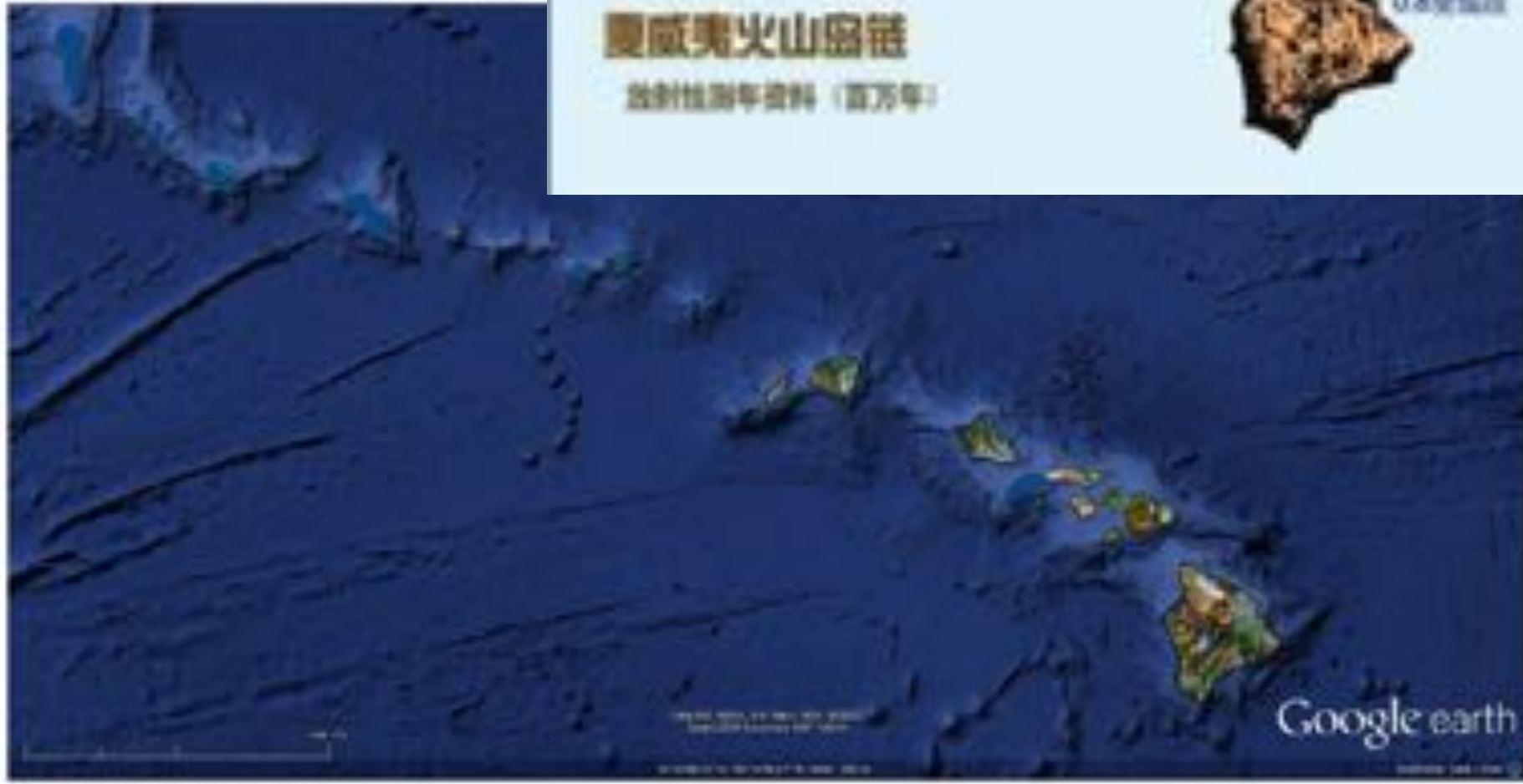
Maui
小于1.0

夏威夷
0.2-0.4亿年前

夏威夷火山岛链

放射状年龄资料 (百万年)

a



Google earth







b



c



b











Fig. 2.10 (a) Vertical basalt columns in southern Iceland, polished by glaciers. (b) The Devil's Postpile, a national monument in the Sierra Nevada of California (USA) showing basalt columns of diameter up to 1 m and the height of individual columns is a natural state of disintegration due to frost weather (Image credit: D. Kallstad)





Fig. 2.11 Explosive ash and smoke eruption at the slope of Mt. Batur on Bali, Indonesia (Image credit: D. Keflati)





长白山



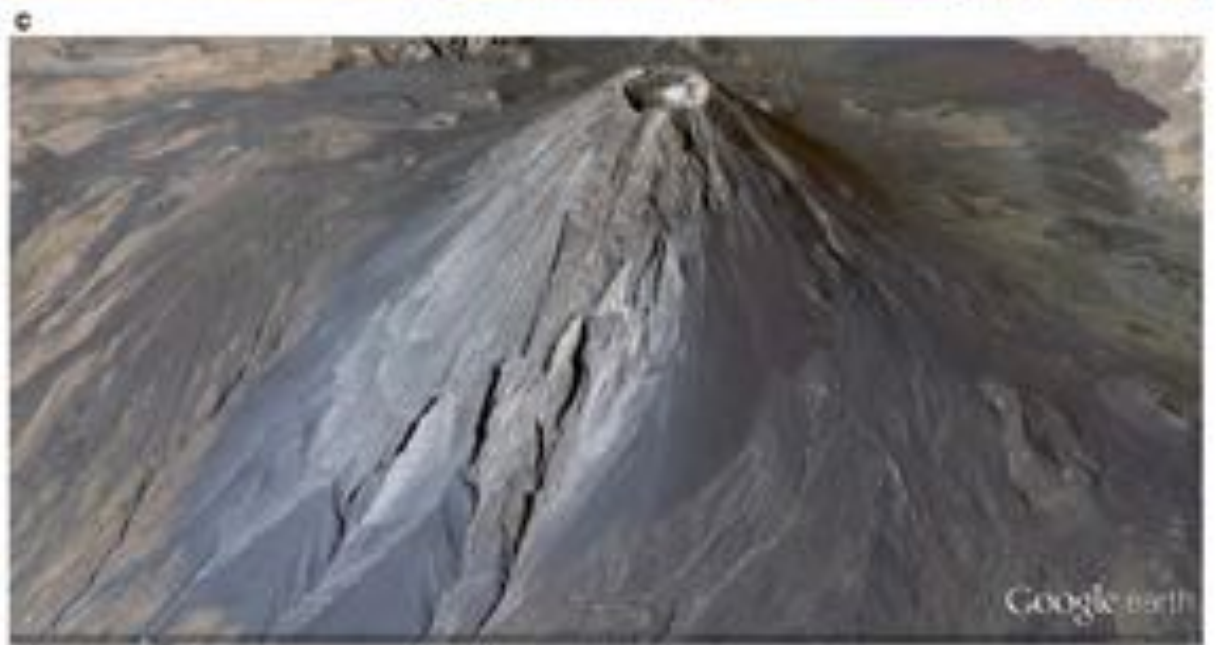


a

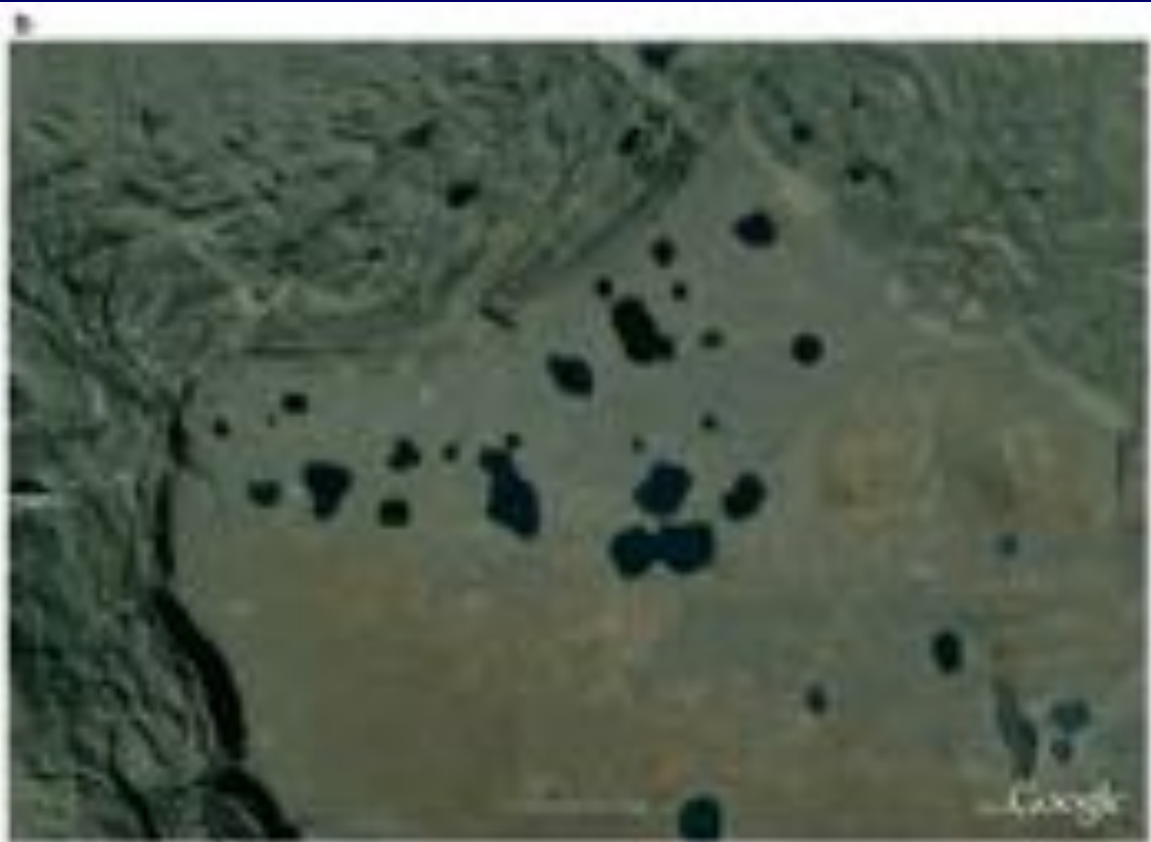


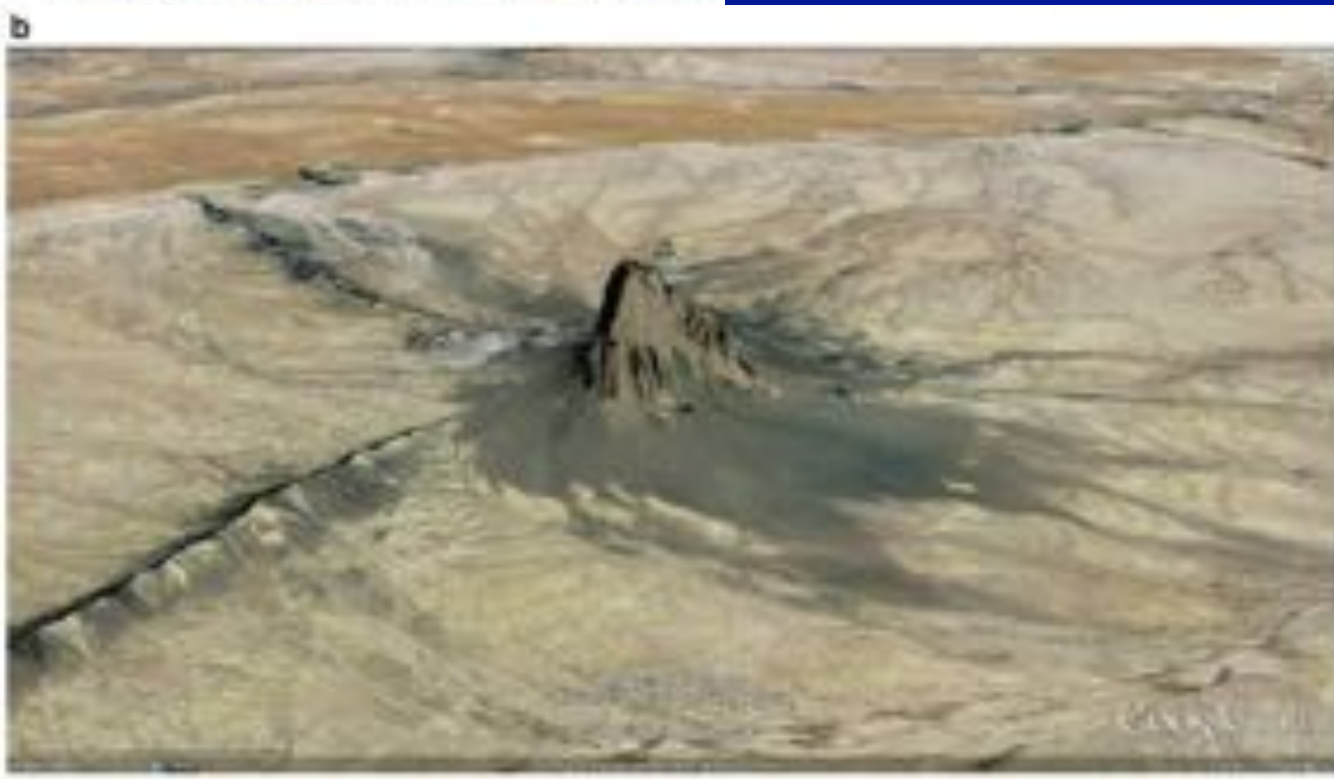
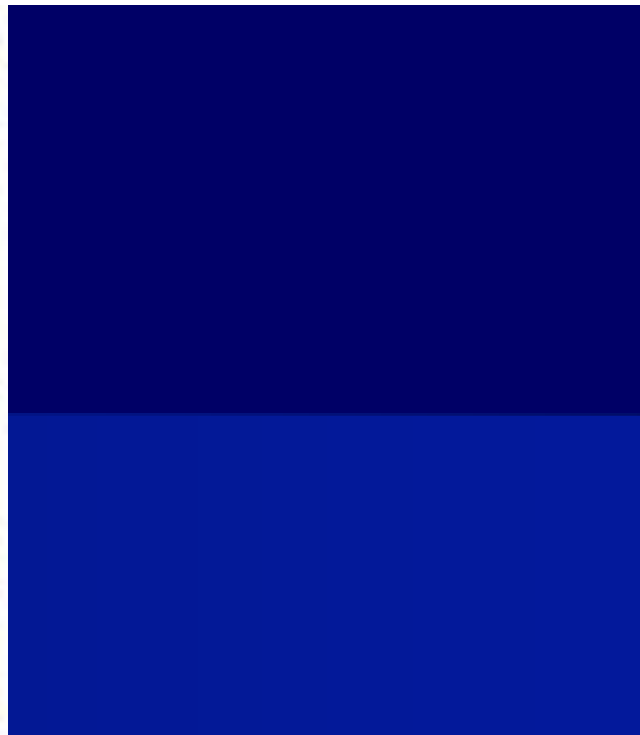
b











锡林郭勒火山







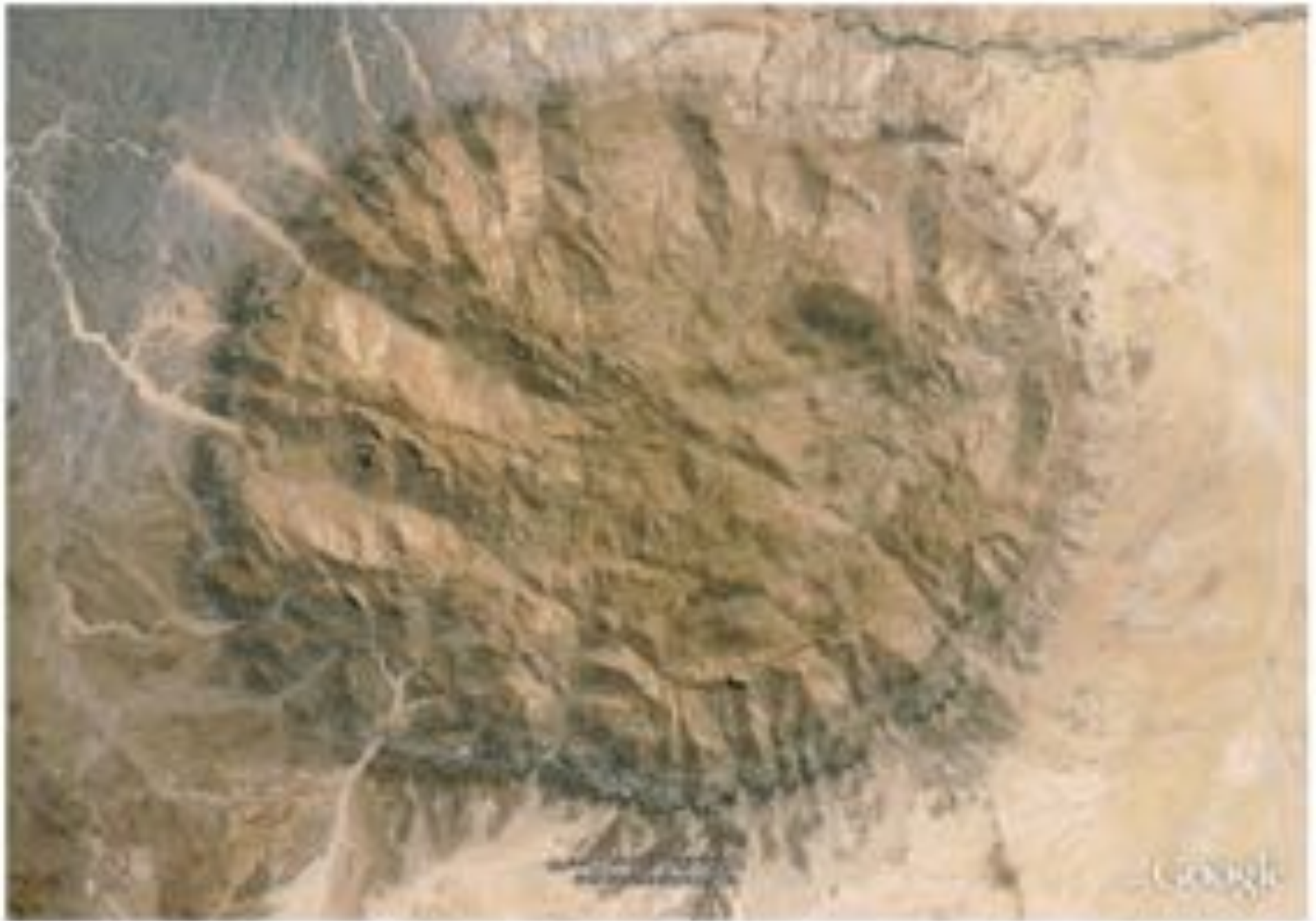
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火成岩地貌



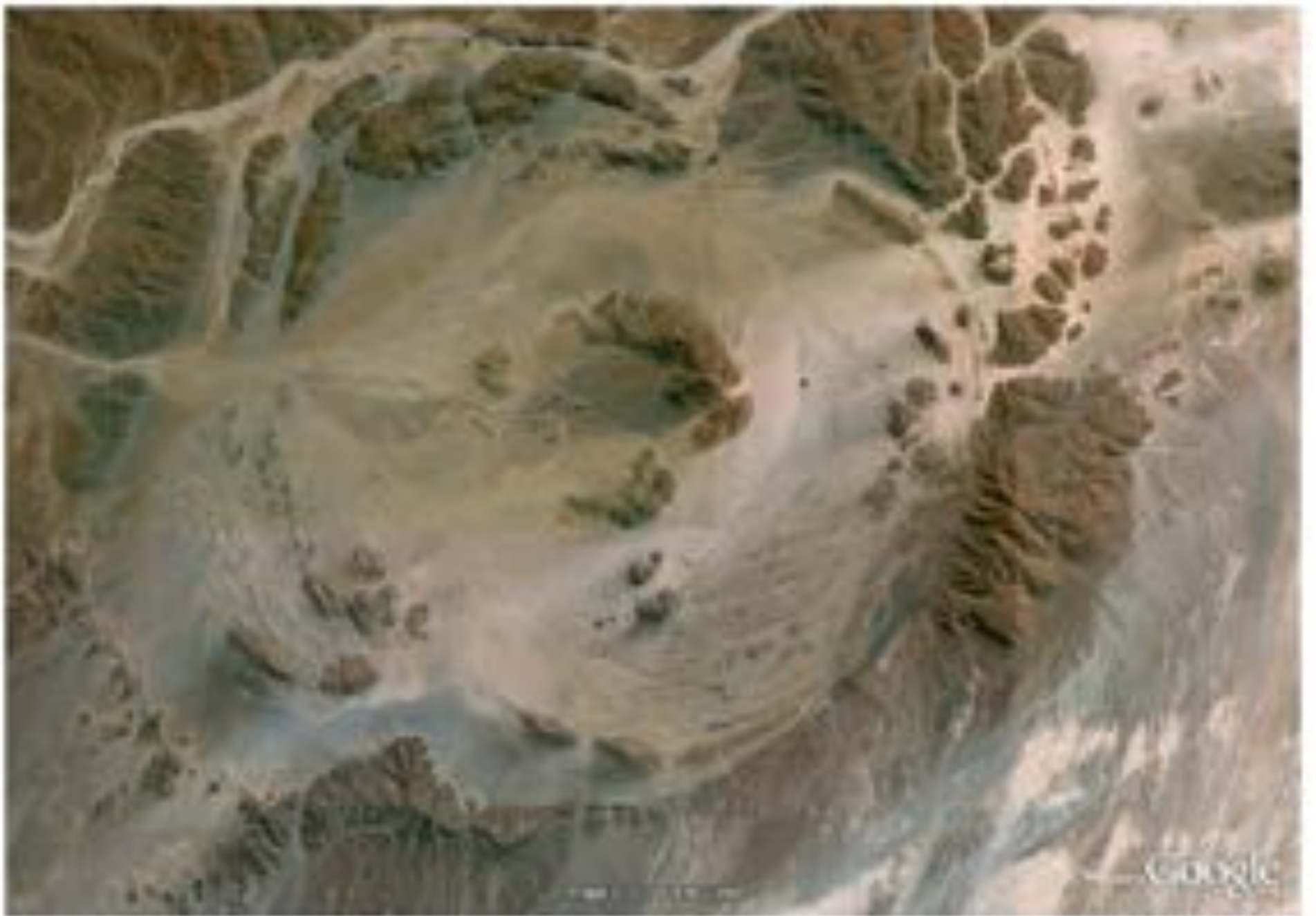
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—Google





Google Earth

1000m

Mount Fuji
Mount Fuji

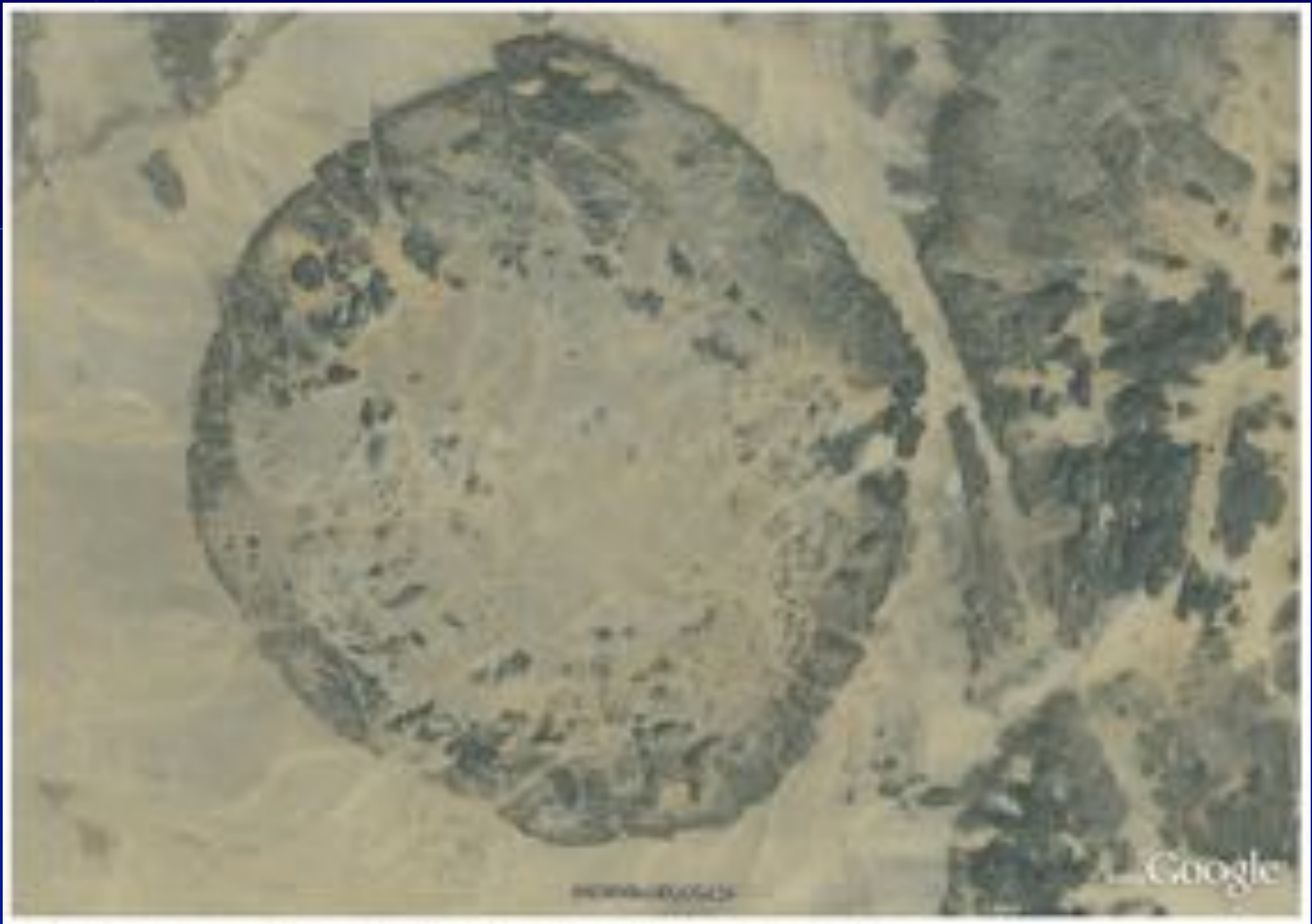
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b



Google



www.google.com

Google



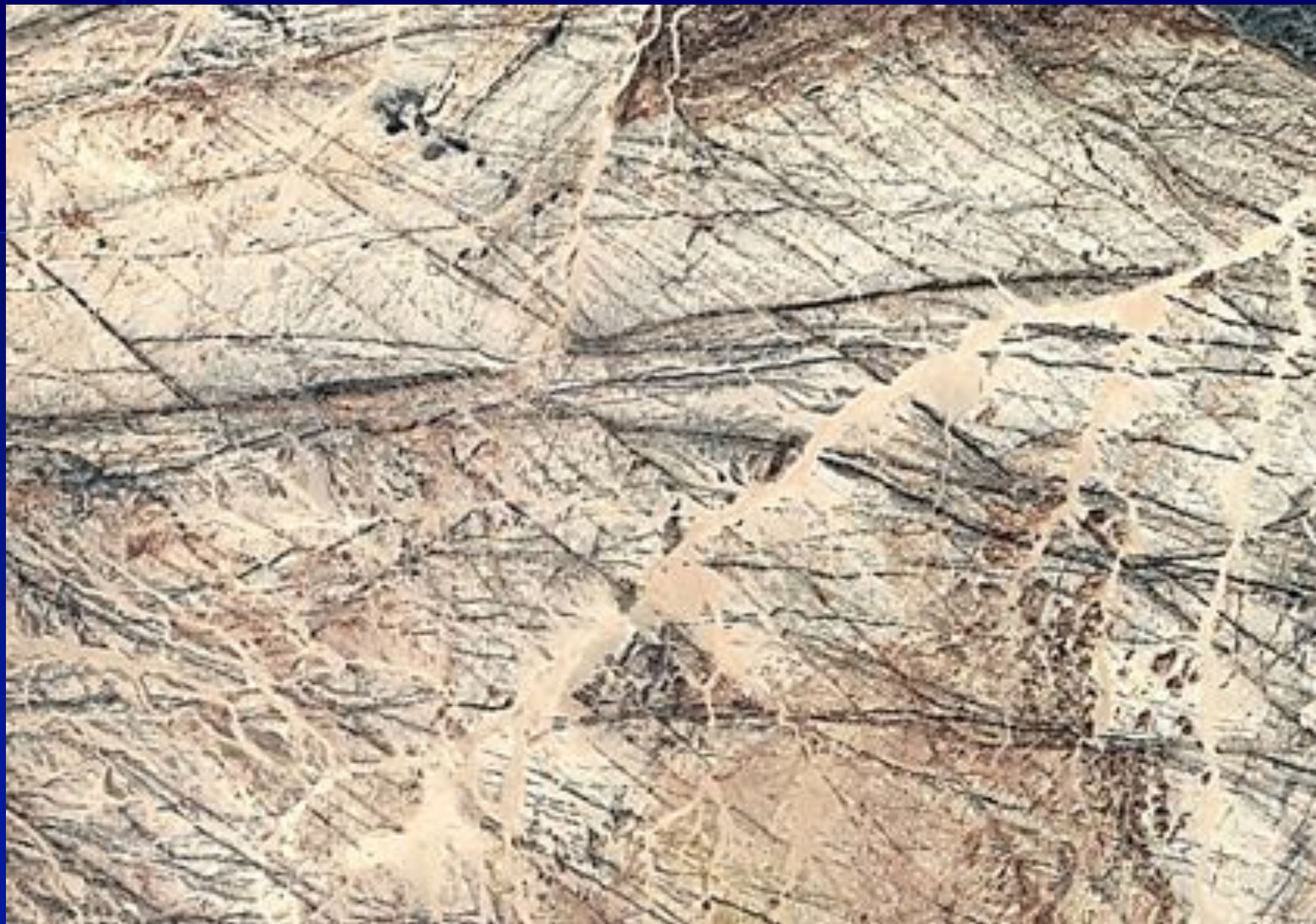












构造地貌



构造地貌是由地壳运动直接形成的或受地质构造控制而形成的地貌类型。

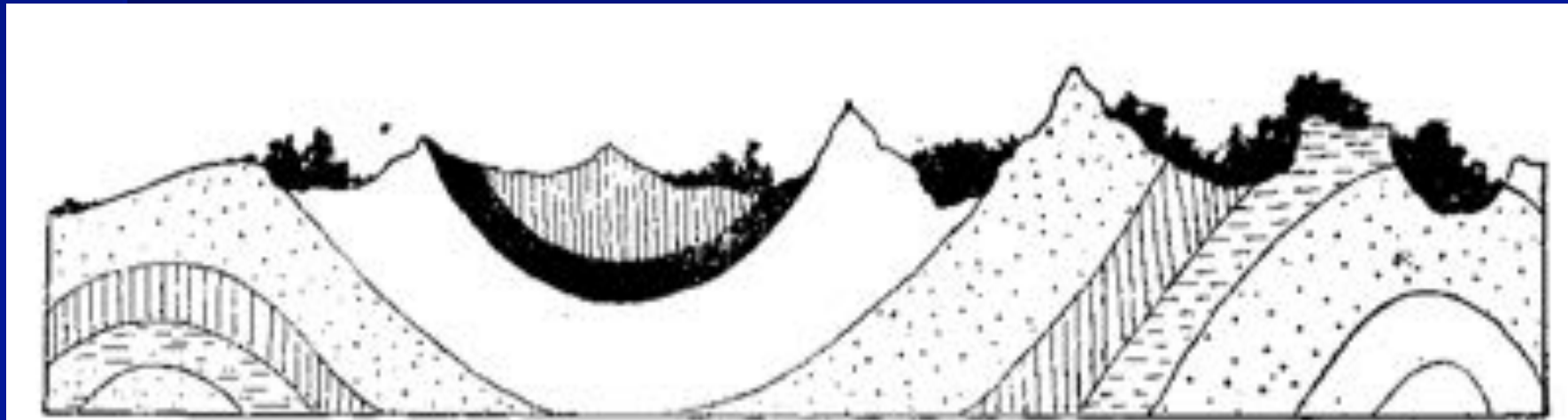
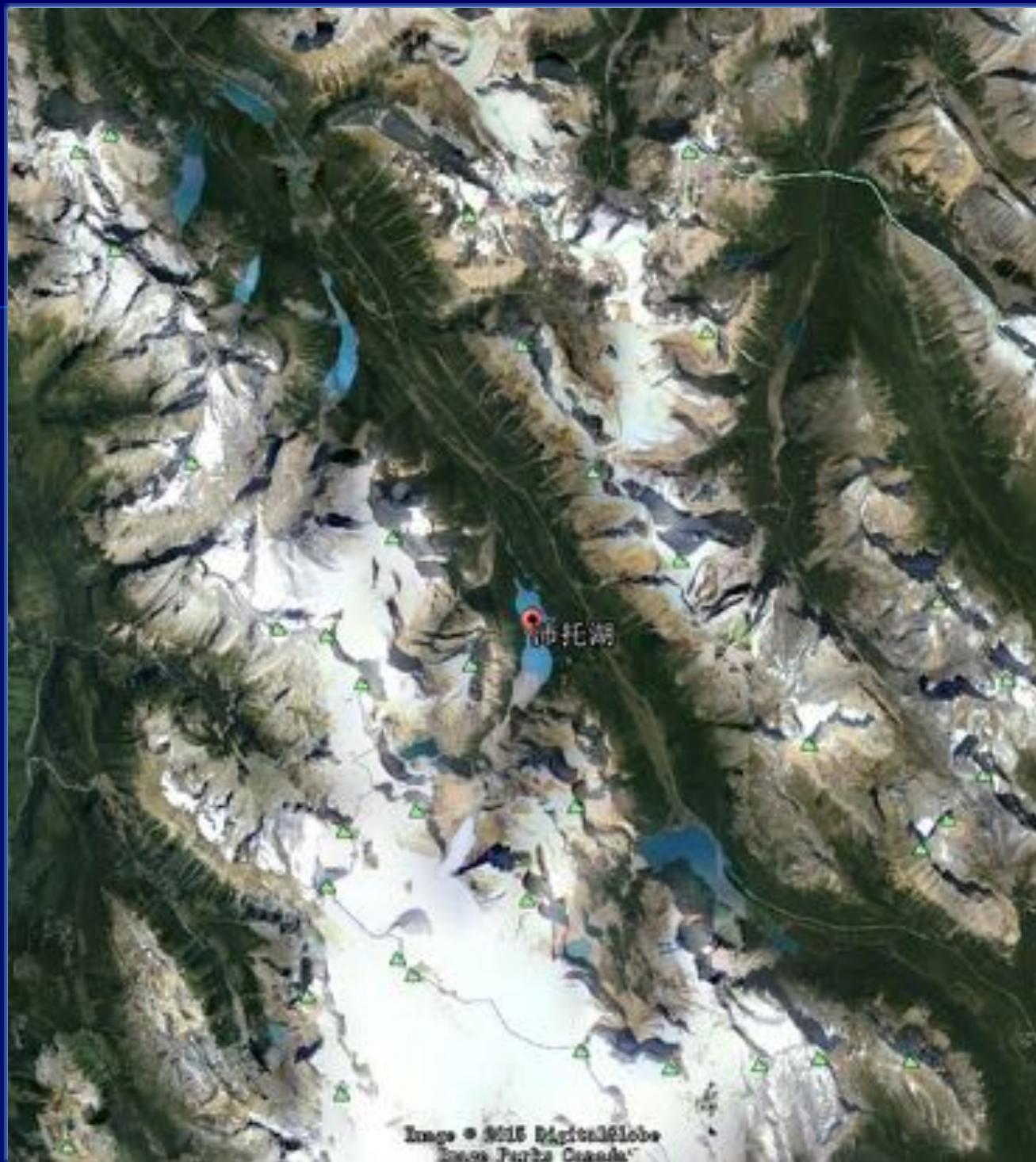


图 6 褶皱山剖面

【逆地形：加拿大落基山脉班夫公园的沛托湖】

- 地形倒置—背斜成谷、向斜成山。
- **沛托湖**是加拿大艾伯塔省落基山脉班夫**国家公园**的一个冰川湖，可以通过冰原公路直接抵达。沛托湖海拔高度为**1880米**，湖泊面积为**5.3平方公里**。
- 名称源于班夫地区早期的一个向导和管理员埃比尼泽·威廉·沛托。**每年夏季，大量冰川岩粉流入湖水中，这些岩石的微粒使湖水呈现出明亮的翠蓝色。**沛托湖的水来源于沛托溪，出口是米斯塔亚河。

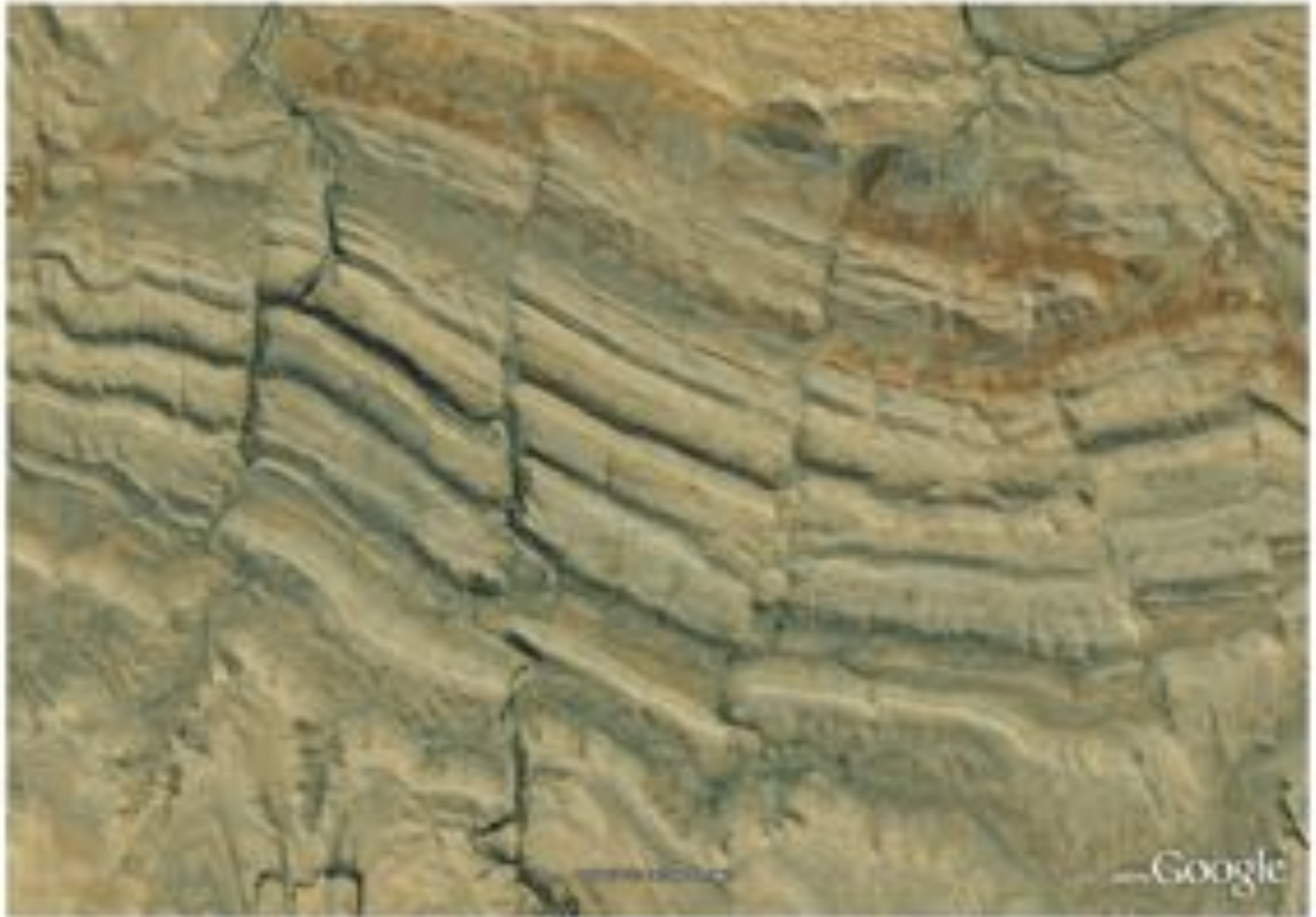








D



—Google

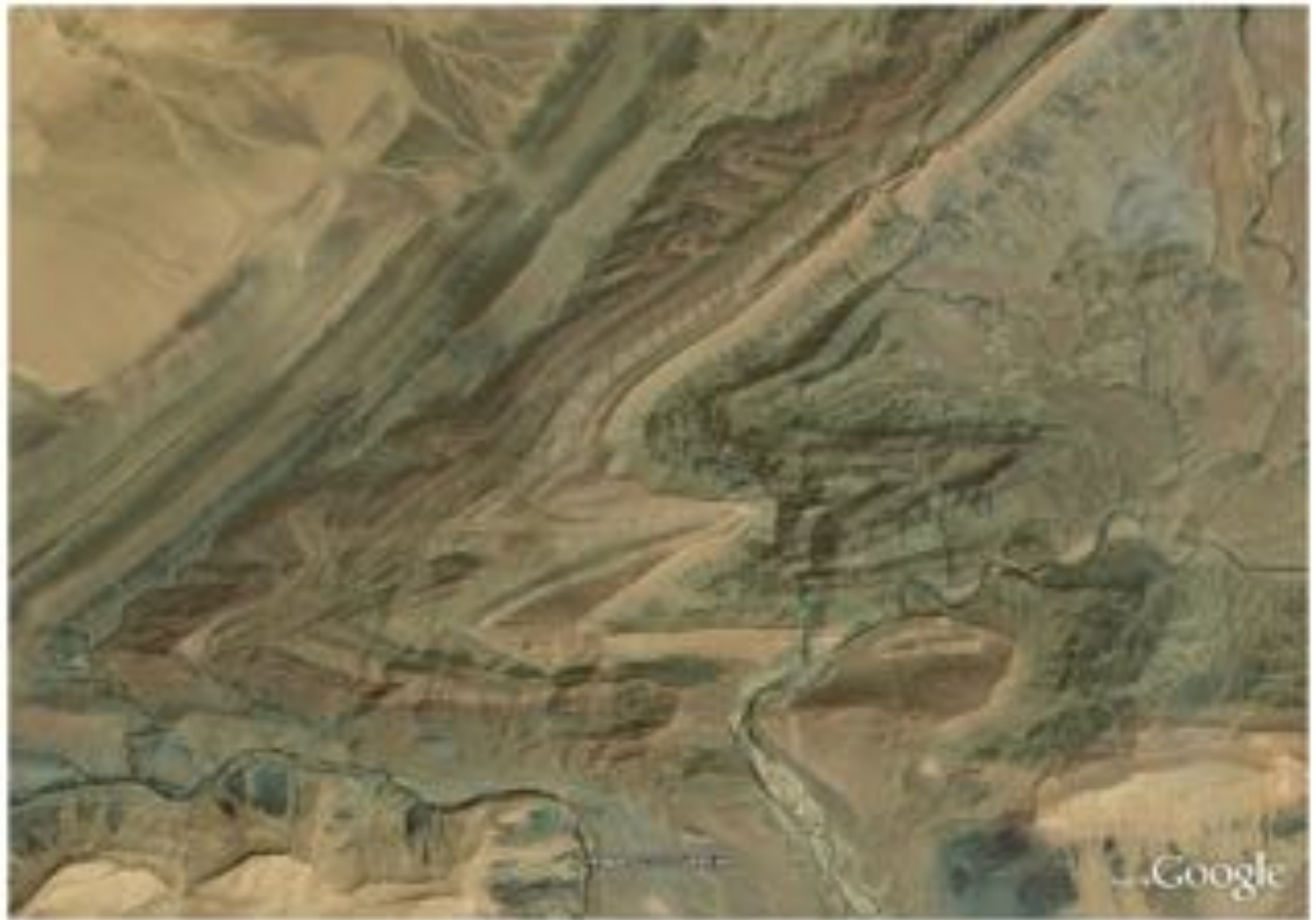




Fig. 4.6 The Appalachian Mountains, often called the Appalachians, are the oldest mountain chain in North America and extend along the eastern margin of the continent for over 2,000 km from Newfoundland, Canada to Alabama, USA. In the valley and ridge province, Paleozoic marine sedimentary rocks are thrust and folded into large anticlines and synclines during a mountain building episode (the Appalachian orogeny) as the two former landmasses, Gondwana and Euramerica, collided approximately 325-260 million years ago. This collision

formed the supercontinent Pangaea, which involved all ancient major continental land masses. Deciduous forests composed mostly of maple, oak and hickory cover most of the Appalachian Mountains at the higher altitudes giving the landscape the scenic beauty when they are changing colors in the fall. Streams, lakes and many state parks and excellent hiking trails provide lots of recreational activities and support a flourishing tourism industry (Image credit: ©Google earth 2012)

8

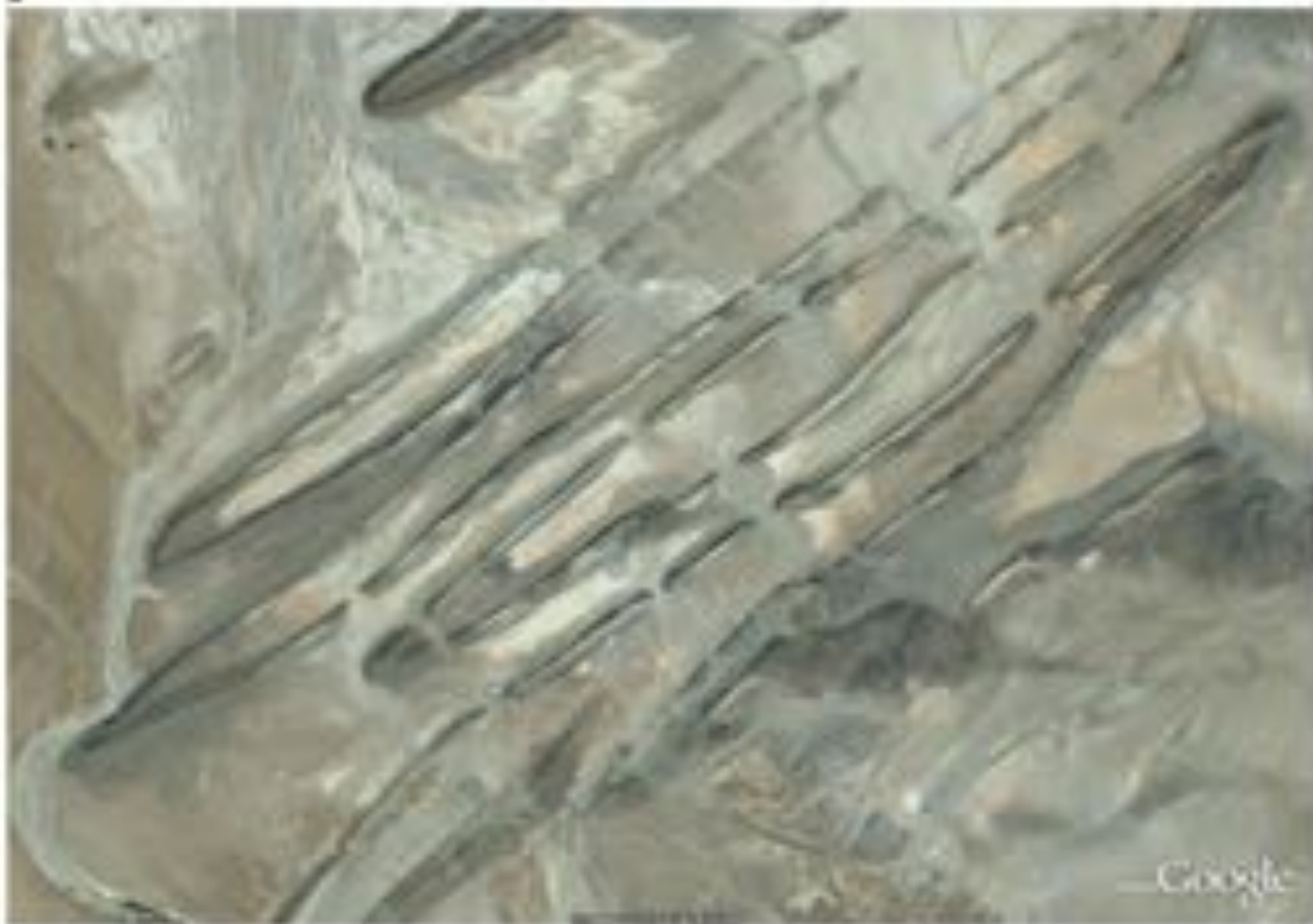


Fig. 4.8 (a, b) Sweeping folding structures north of Morocco's Anti-Atlas. The Anti-Atlas range formed in the Palaeozoic era during the same orogeny as the Appalachians. (a) An enlarged section of the image above. (b) Google earth 2012



c



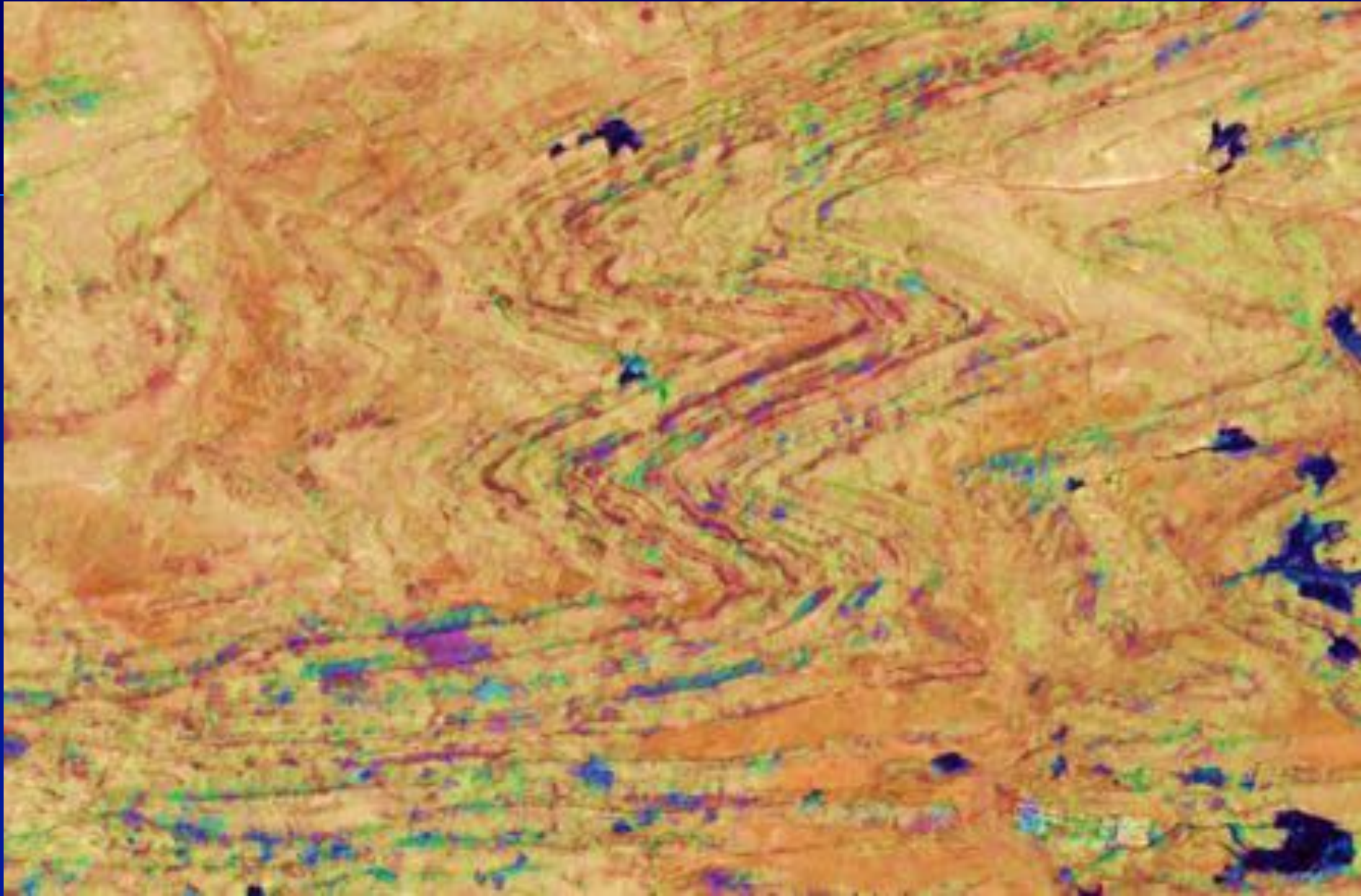




Fig. 4.9 The Flinders River in central Australia crosses an anticline structure of 45 km width at 24°09'3" and 132°32'2"E. Rock strata abruptly dip towards the north and south, and the anticline hinge plunges towards the west in its western part, the character of an anticline with the oldest strata in the center is evident. The valley of the Flinders River is an incredibly old river system that follows exactly the same course for the past 15-20 million years and generally flowed along the same path for 100

million years. It has existed before the anticline structure was enhanced by uplifting and denudation, but the river kept its course and incised this valley in pace with the uplift. This keeping pace is called "antecedence" because the river is older than the structure it is cutting. Aboriginal mythology believes that the Flinders River was formed when the Rainbow Serpent traveled north from Lake Eyre (Image credit: ©Google earth 2017)



b





Fig. 4.13 The famous synclinal structure of Wilpena Pound, Flinders Ranges (South Australia) forms an almost closed basin. Mountain ranges surrounding the remnant valley have been eroded away during the last several million years. The higher walls of Wilpena Pound are

composed of quartzite, a metamorphic rock converted from sandstone by elevated temperature and pressure, which is very resistant to weathering (Image credit: ©Google earth 2012)



Fig. 4.14 A beautiful syncline in the Andes Mountains of northwest Argentina, exposing Jurassic rock formations. Large-scale erosion accompanying the uplift during the Andean orogeny has removed the adjacent (anticline) parts of these rock formations, but the trough-like

syncline persisted. Picture-perfect cuestas have developed towards the center of the structure, where inclined layers of sedimentary rocks of different colors are incised by draining channels (Image credit: ©Google earth 2012)

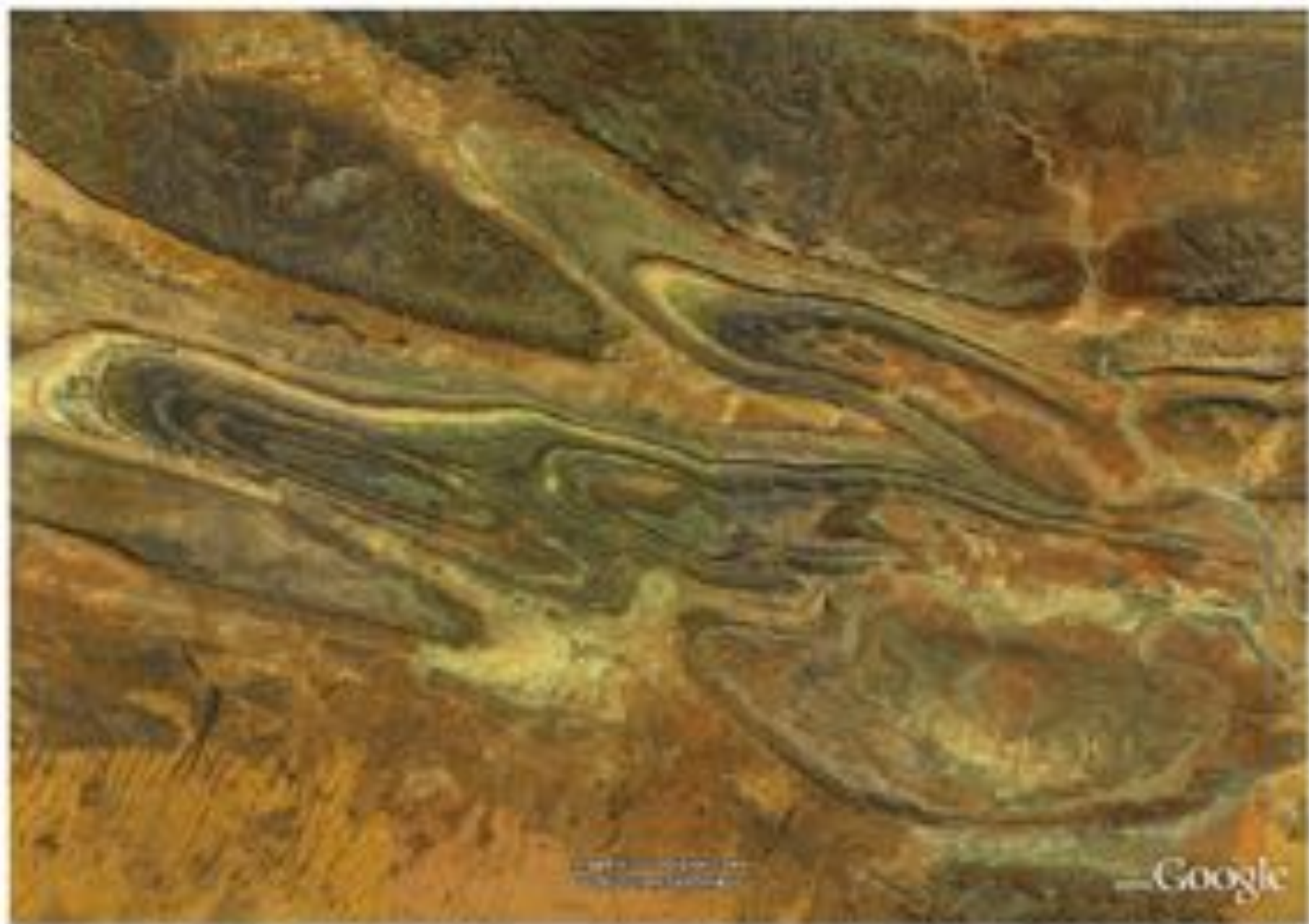


Fig. 4.10 Complex deformation patterns in the vast and spectacular sedimentary rocks of the MacDonnell Ranges near Alice Springs in central Australia. Folds are disturbed by faulting, as a result of crustal compression. Viewed from above, they speak eloquently of the caterpillar-drawing that is at the heart of local Aboriginal mythology of the

Ansonia people, the traditional custodians of this area of Australia. For them, this is where ancestral creation beings – including caterpillars and wild dogs – travelled the land, naming and shaping prominent elements in the vast landscape. The scene is about 50 km wide, centred at about 24°27' and 137°07' (image credit: ©Google earth 2012)



Fig. 4.11 Overview of the detailed pictures shown in Figs. 4.9 and 4.10. The compressional folding structures are easy to follow in this image, 112 km wide and centered near 24°12'N and 112°40'E. The

Goswami's Bluff impact crater (see Chap. 5) is visible in the northern part of the image (image credit: ©Google earth 2012)

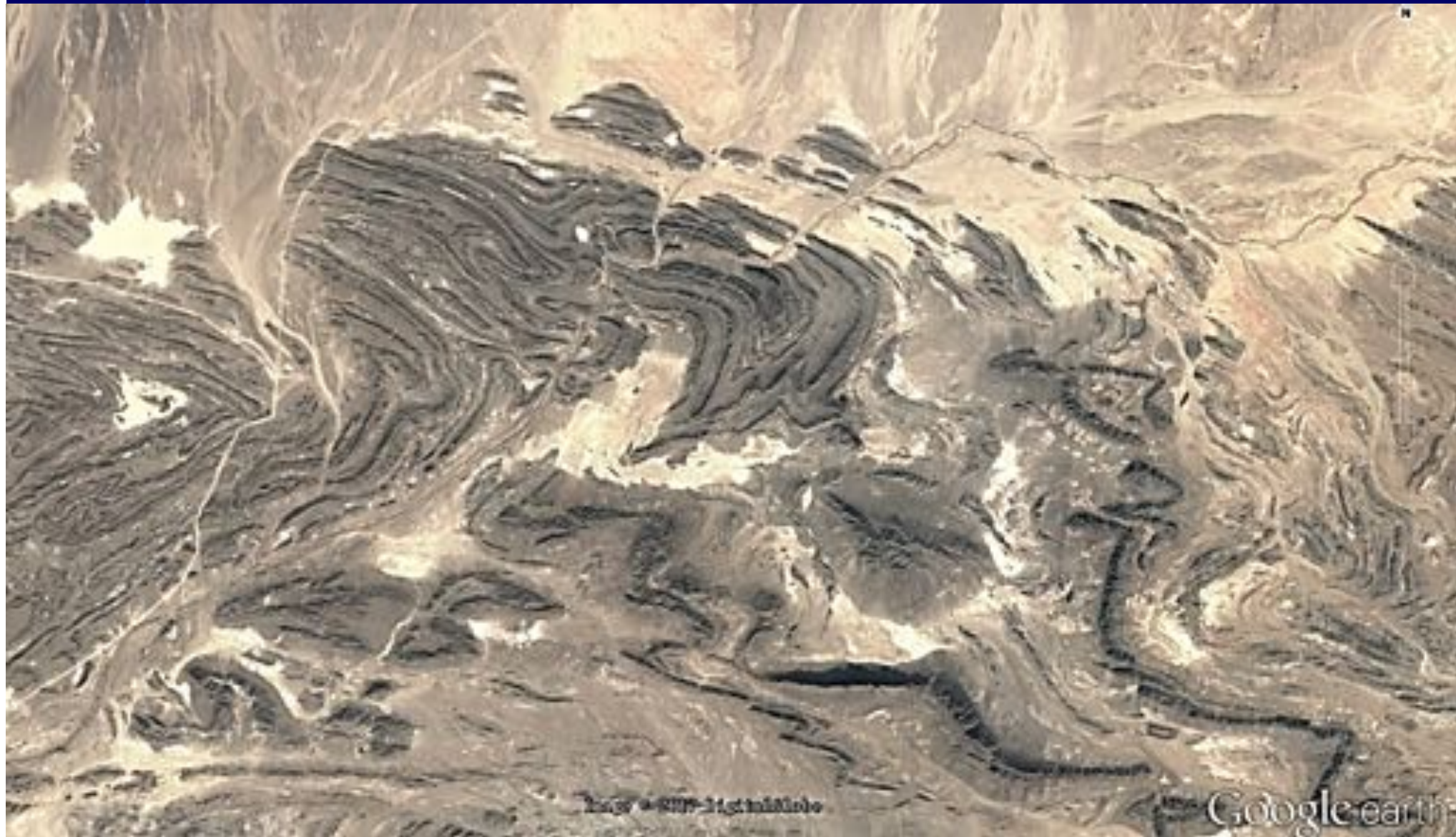


Image © 2007 DigitalGlobe

Google earth



Fig. 4.15 If the inclination of rock layers is significant (here with about 8° to the south in southern Morocco), the cuestas show a differentiated dissection by infrequent, but severe rainfalls ($28^\circ 19'N$, $9^\circ 44'W$, 38 km wide) (Image credit: ©Google earth 2012)

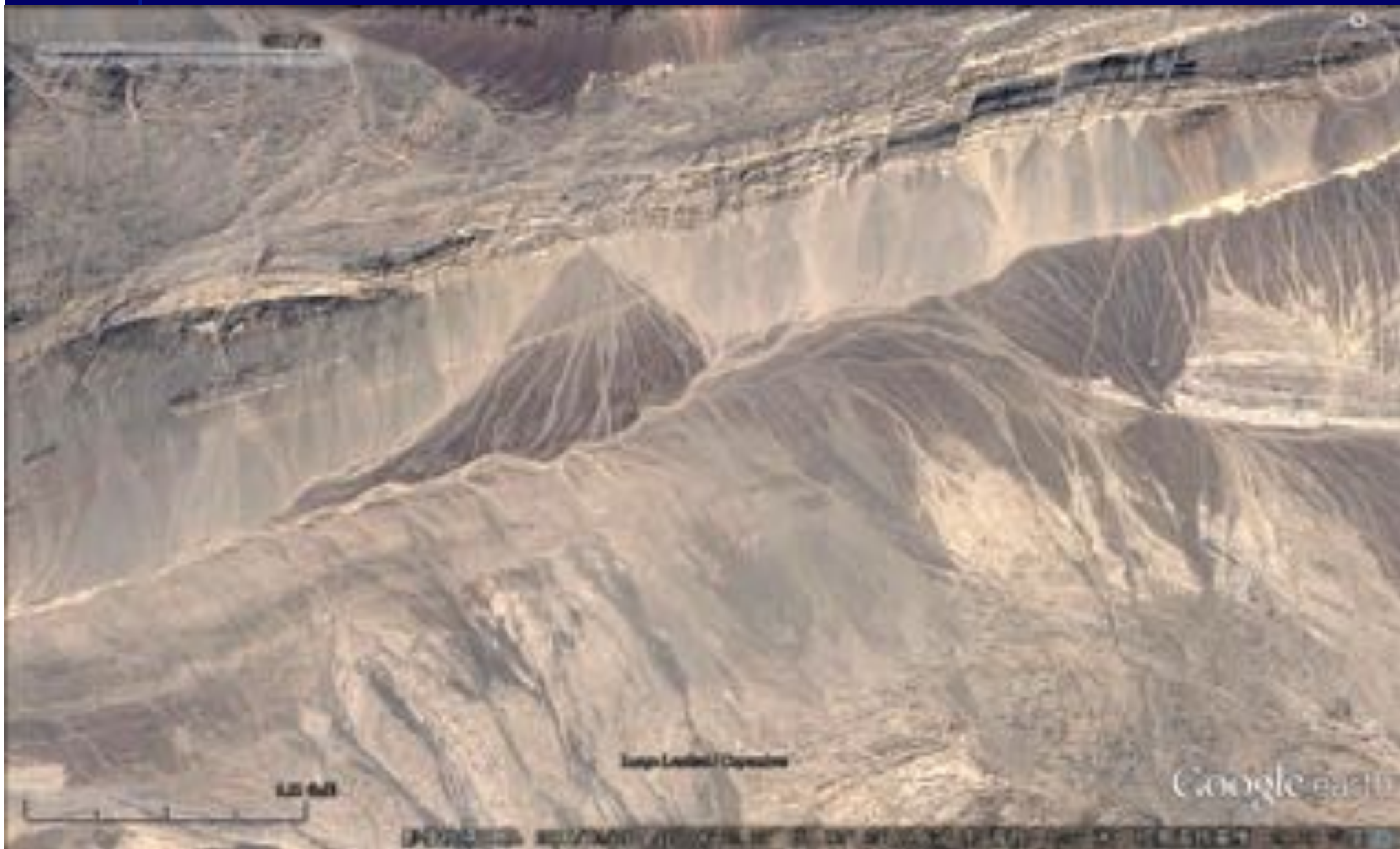


a



b





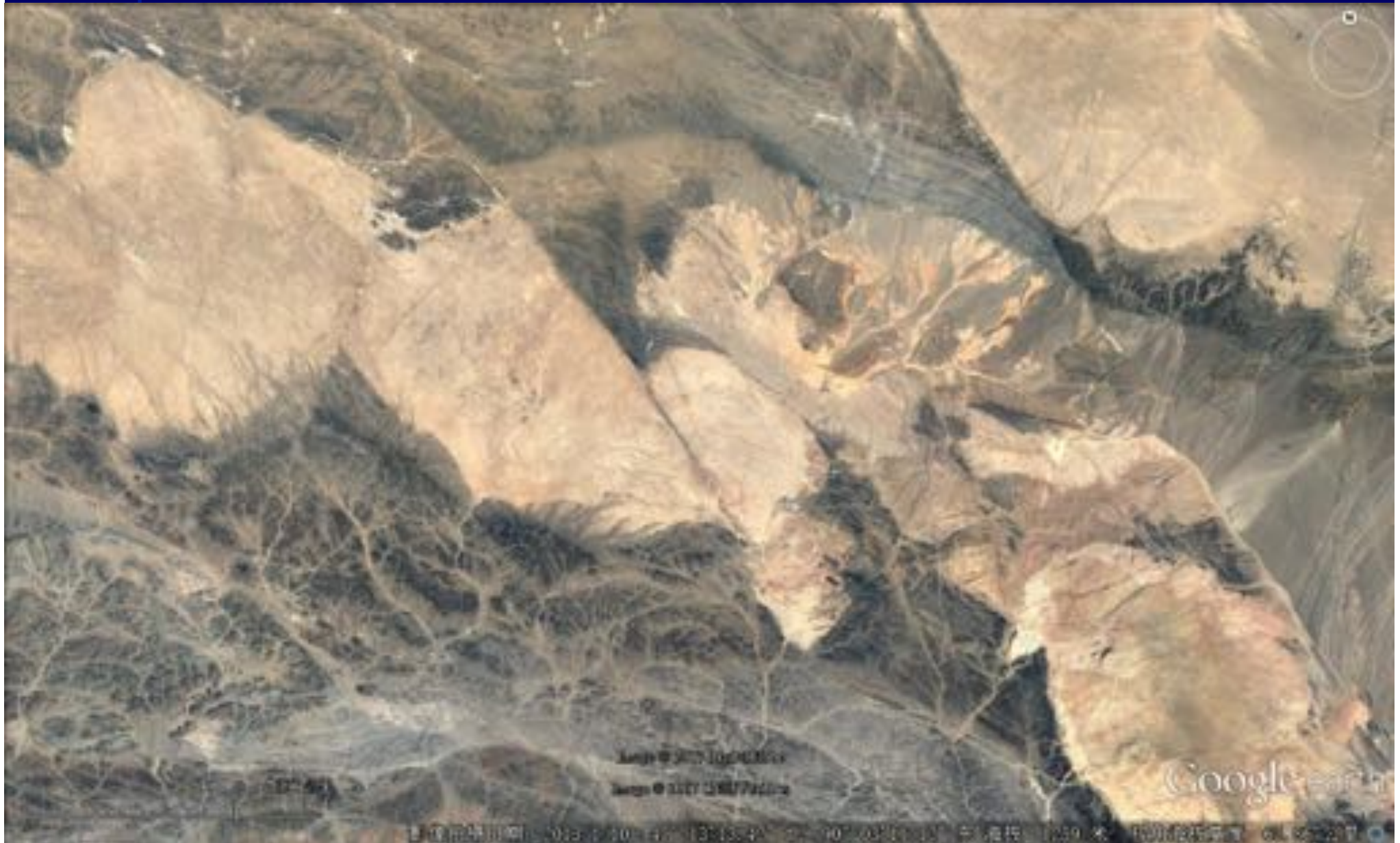


Image © 2010 Google Earth
Image © 2010 Google Earth

Google Earth

© 2010 Google





宁波市 余姚市

宁波市 余姚市

Google earth

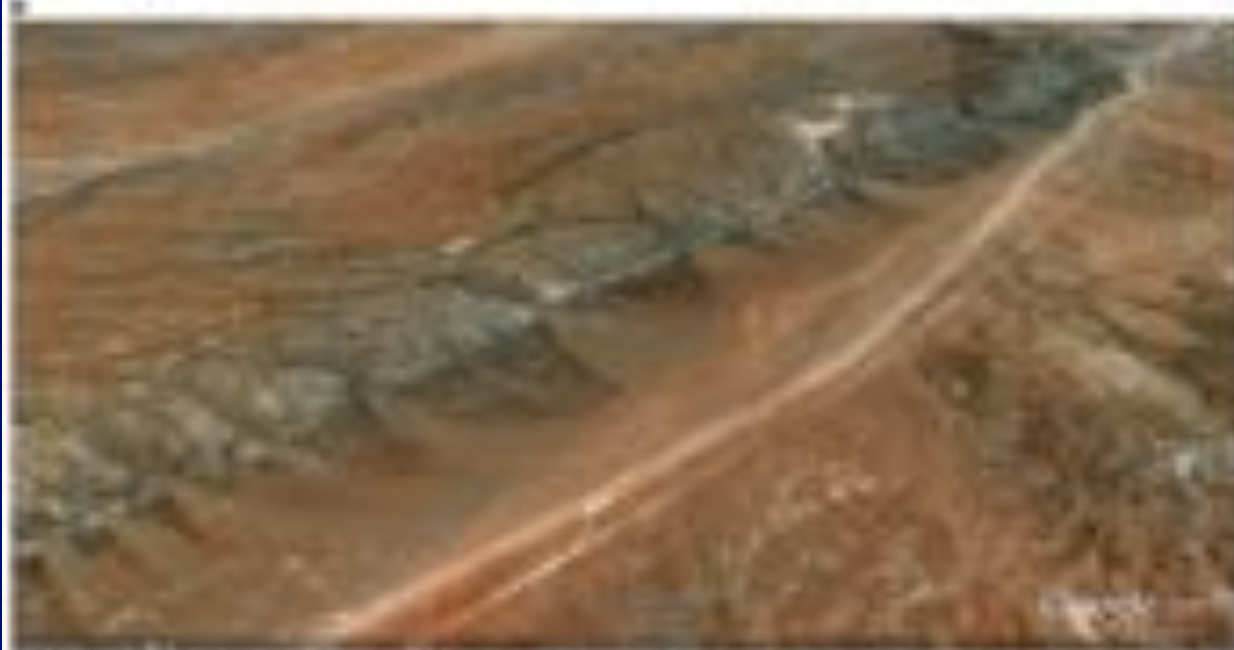
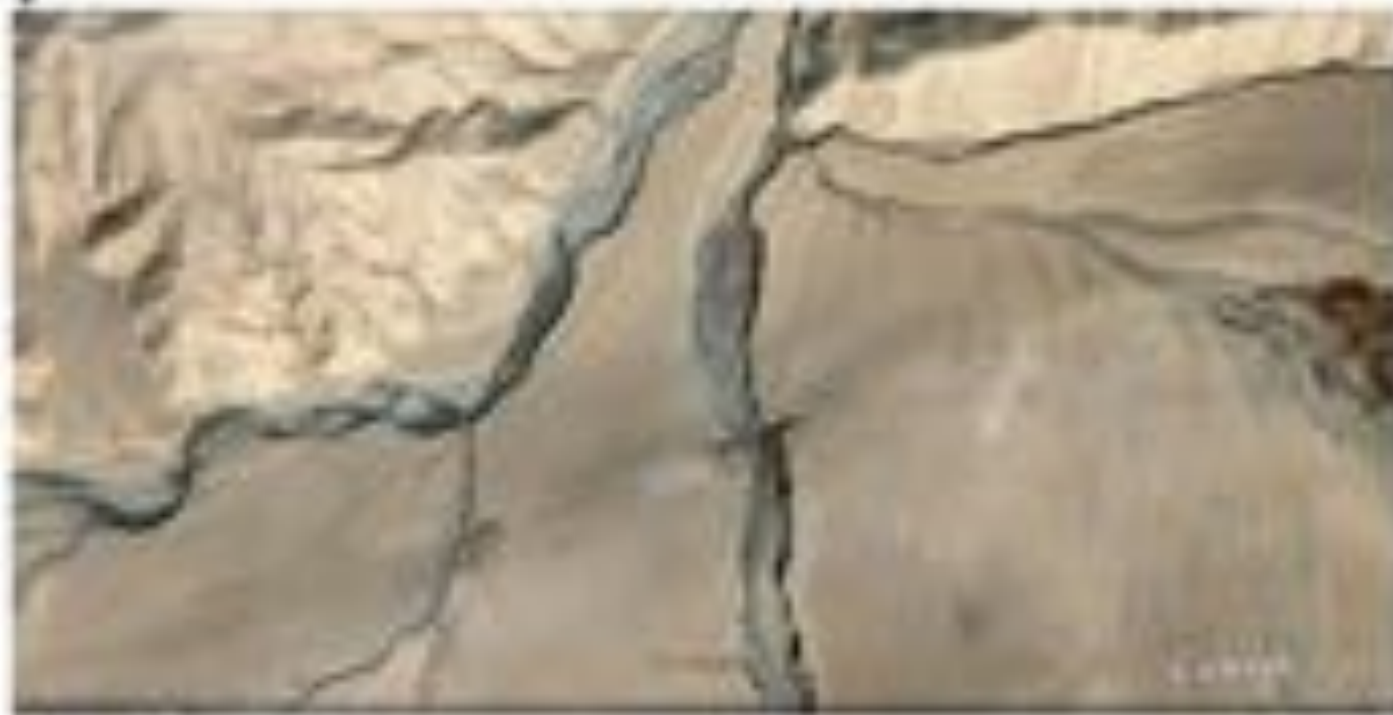


Fig. 4.22 (a) The fault in the rock face is a fault consisting from rock-surface to rock-surface is formed by several straight fractures, resulting in a continuously irregular surface along its both sides of the fault. (b) The fault surface is a fault consisting from rock-surface to rock-surface is formed by several straight fractures, resulting in a continuously irregular surface along its both sides of the fault. (c) The fault surface is a fault consisting from rock-surface to rock-surface is formed by several straight fractures, resulting in a continuously irregular surface along its both sides of the fault.

some fault also a fault with prominent vertical fracture in the fault along the fault zone, sometimes observed from both sides of the vertical fracture and located in the W part of the fault zone (including 1000m long fault - 1000m long fault).





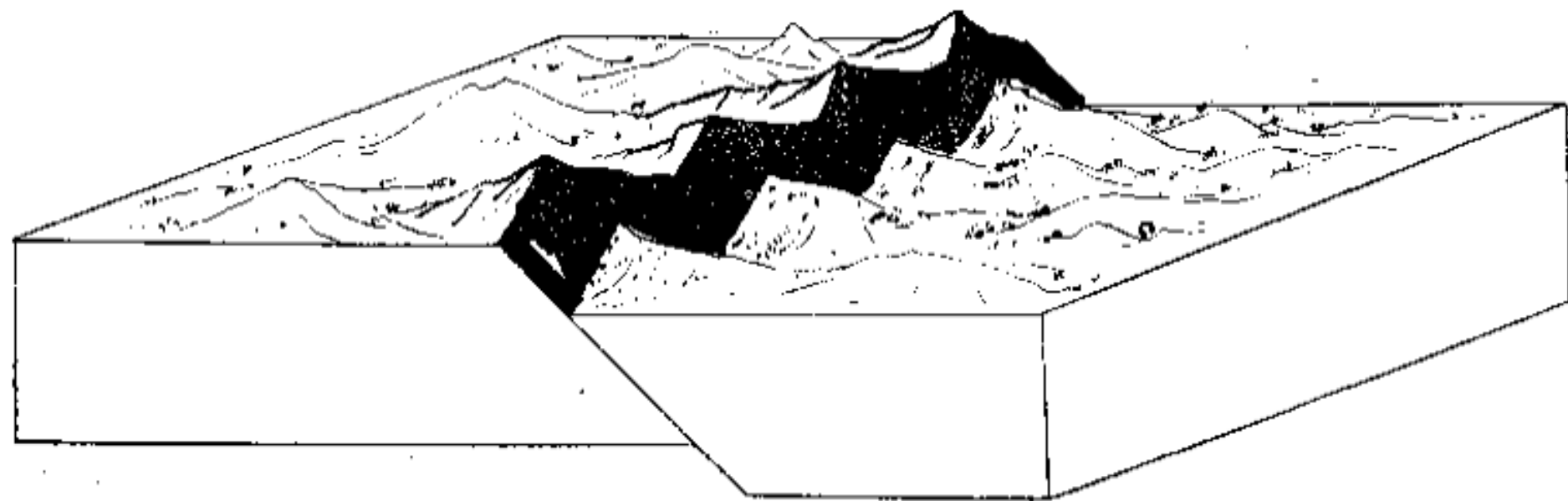


图 9 正断层形成的地貌示意图

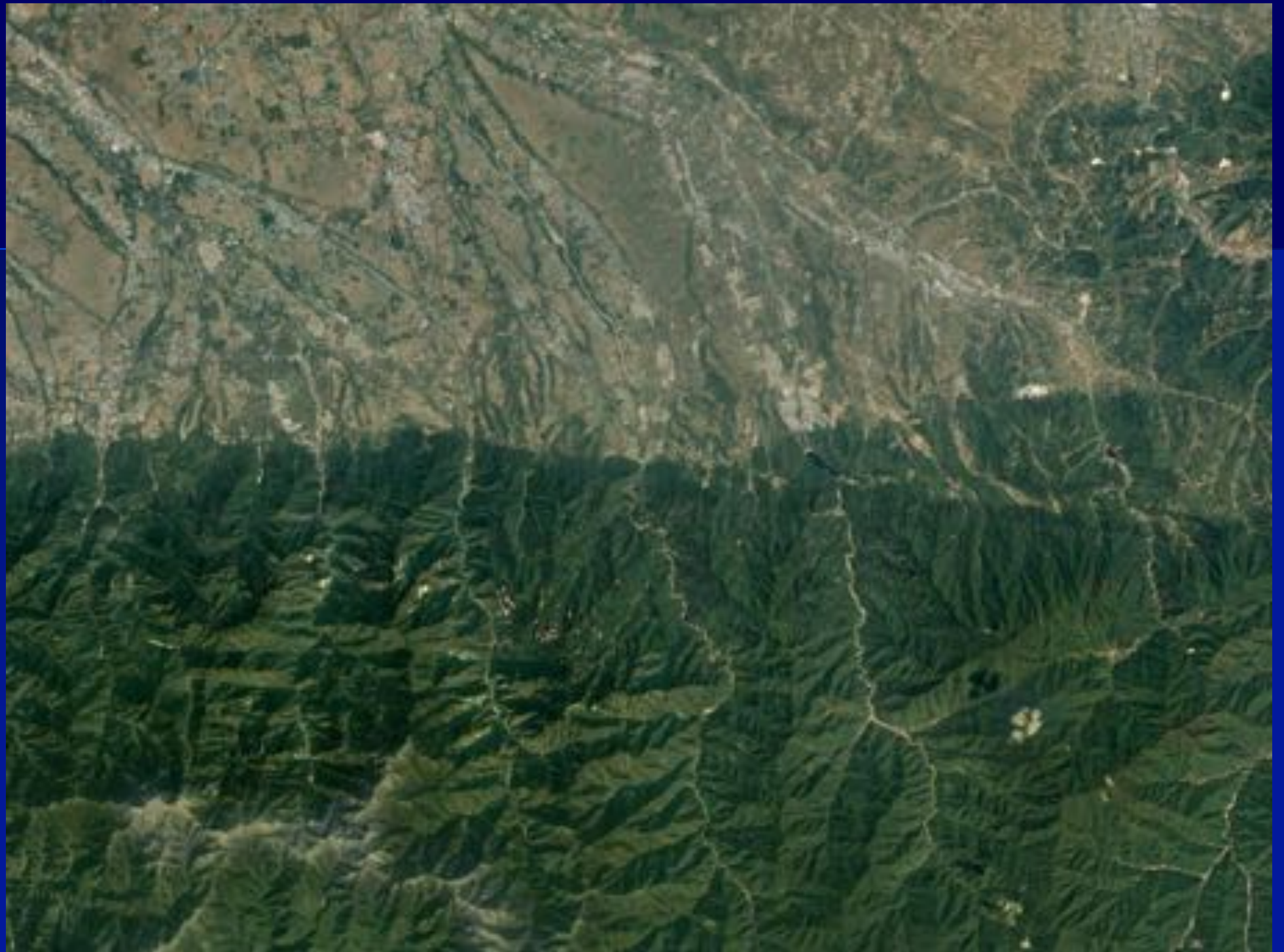






Fig. 4.24 A joint pattern in a limestone landscape in southern Andalusia, Spain, at $36^{\circ}37'N$, $4^{\circ}27'W$. Scene is 3.7 km wide (Image credit: ©Google earth 2012)



Fig. 4.26 The rock formation in southern Jordan ($29^{\circ}17'1.29''N$, $35^{\circ}29'34.34''E$) has been deeply incised by erosion along the main joints – more and more small jointing patterns are exposed by ongoing

weathering and subsequent erosion during infrequent but heavy rains (6 km wide scene) (Image credit: ©Google earth 2012)



Fig. 4.28 (a) Intensely weathered joints in very old rocks (about 2 billion years) in northwest Australia at $17^{\circ}50'N$, $113^{\circ}20'E$ (10 km wide section). There is a "hierarchy" of dominant primary and secondary joint patterns, which likely is either the result of different tectonic stress

or just an expression of time of exposure to weathering processes to explore even the finest weak fractures in the rock. (b) Detail of the landscape in Fig. 4.28a, 5 km wide (Image credit: ©Google earth 2012)



Fig. 4.31 (a, b) The Arches National Park in Utah, USA, exhibits fine examples of jointing caused by an anticline uplift of a salt dome which has stretched and pulled apart the overlying rock strata

(38°47'N, 109°20'W; about 4.5 km wide scene). (c) Detailed image showing secondary joints cross-cutting the dominant joints. Width of this image is just 2 km (image credit: ©Google earth 2012)





Fig. 4.34 Upheaval Dome is a salt intrusion with a cap of gypsum pushing up the top sandstone layers in Canyonlands National Park, Utah, USA, at $38^{\circ}26'N$ and $109^{\circ}35'W$. The round structure has a diameter of

about 3.2 km. In earlier days, the feature was interpreted to be of volcanic origin or as an impact crater (Image credit: ©Google earth 2012)

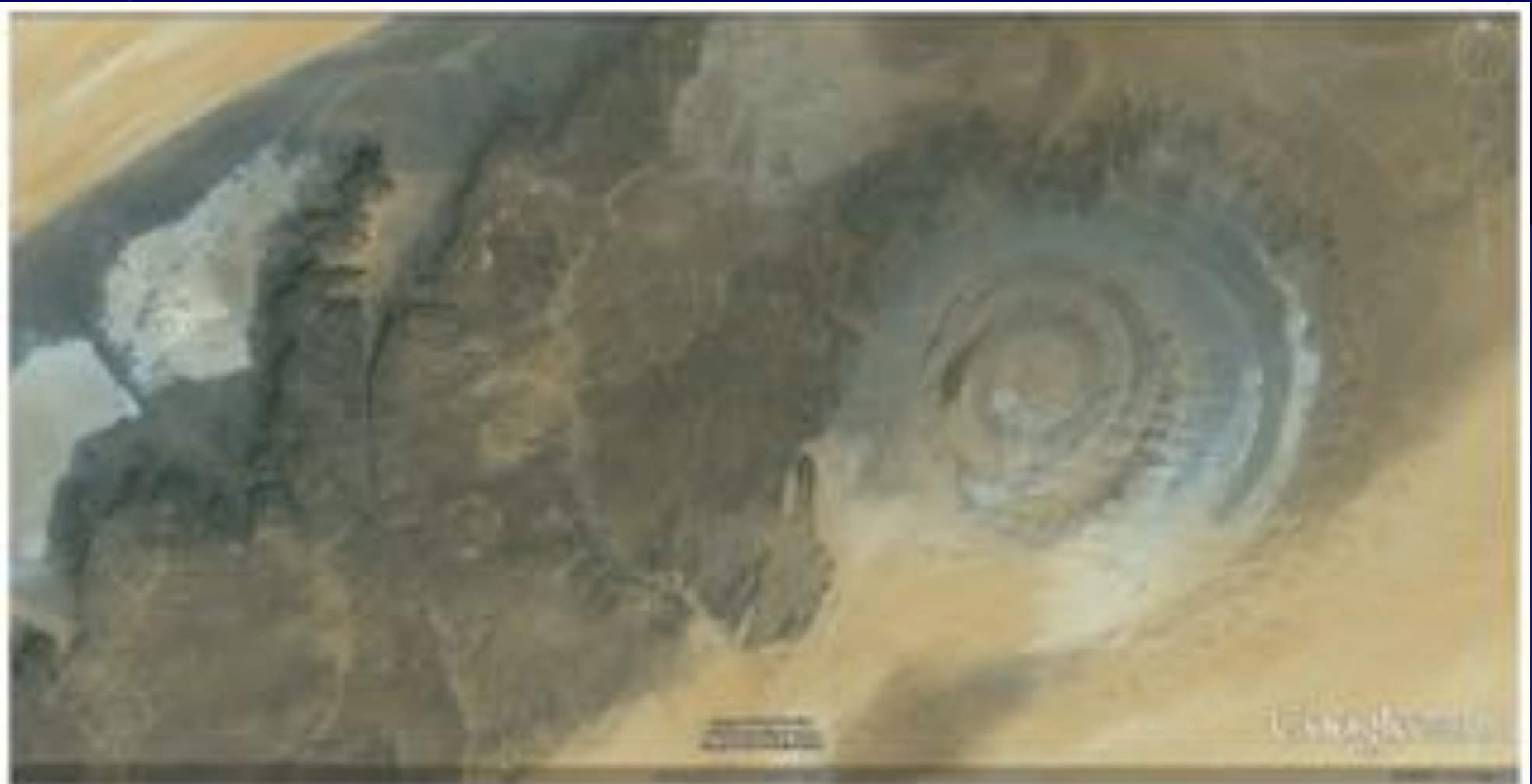


Fig. 4.35 The famous Richat Structure. This prominent circular feature in the Sahara Desert of Mauritania (southwest Africa) has attracted much attention since the earliest space missions because it forms a conspicuous bull's-eye that has become a landmark for shuttle crews in the otherwise rather featureless expanse of the desert. Initially interpreted

as a meteorite impact structure because of its high degree of circularity, it is now thought to be merely a symmetrical uplift that has been sculptured here by erosion. Palaeozoic quartzites form the resistant beds outlining the structure (Image credit: ©Google earth 2012)



Fig. 4.38 (a, b) In central Patagonia (Argentina) at 37°51'S and 69°44'W, layers of rock strata in a mudstone/siltstone sequence can be distinguished by their changing colors (Image credit: ©Google earth 2012)



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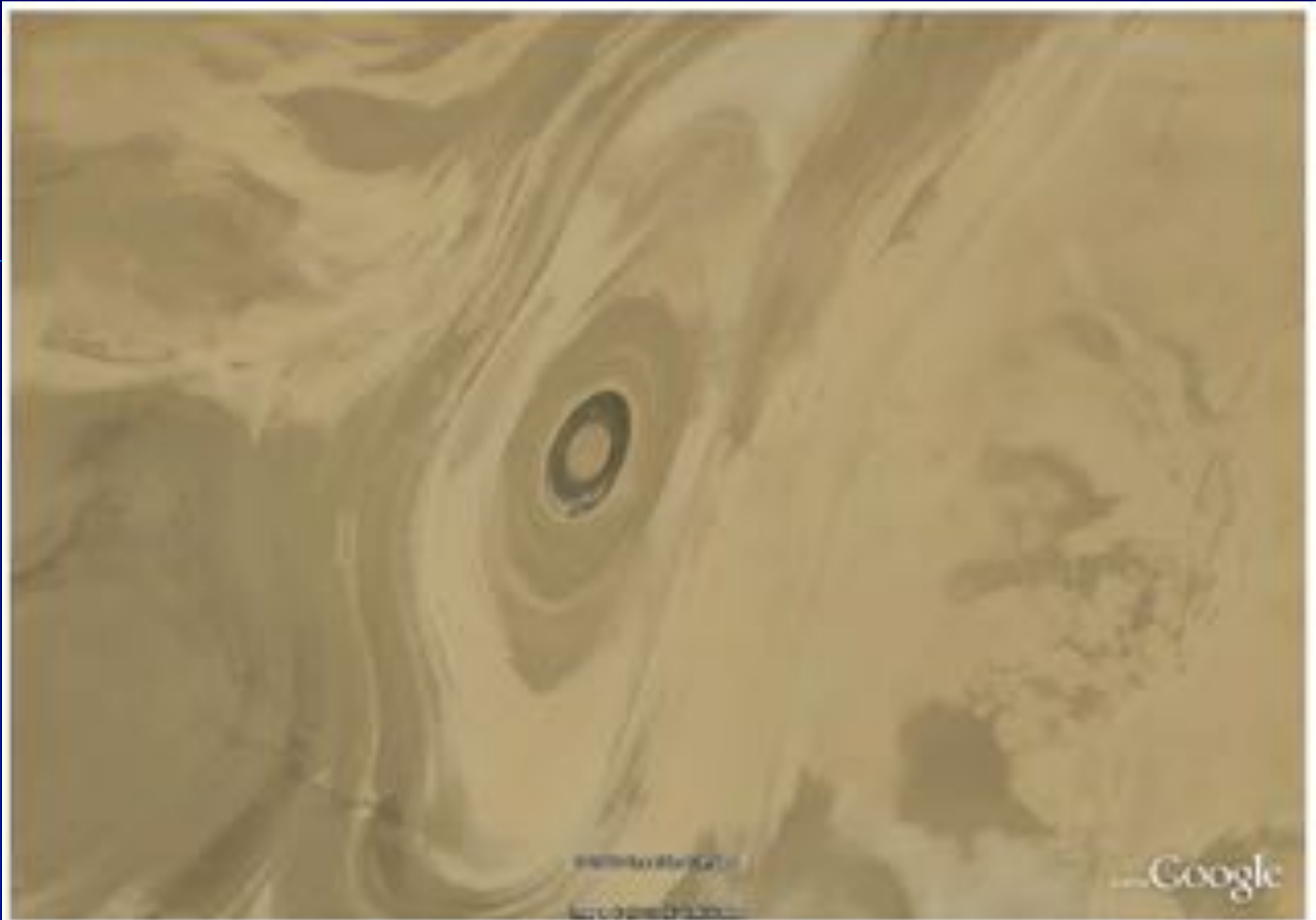


Fig. 4.39 In northern Iran, wind erosion exposes different mudstone and sandstone sequences in ancient basins (related to salt tectonics) at about $34^{\circ}42'N$ and $53^{\circ}11'E$. Width of scene is 12 km (Image credit: ©Google earth 2012)

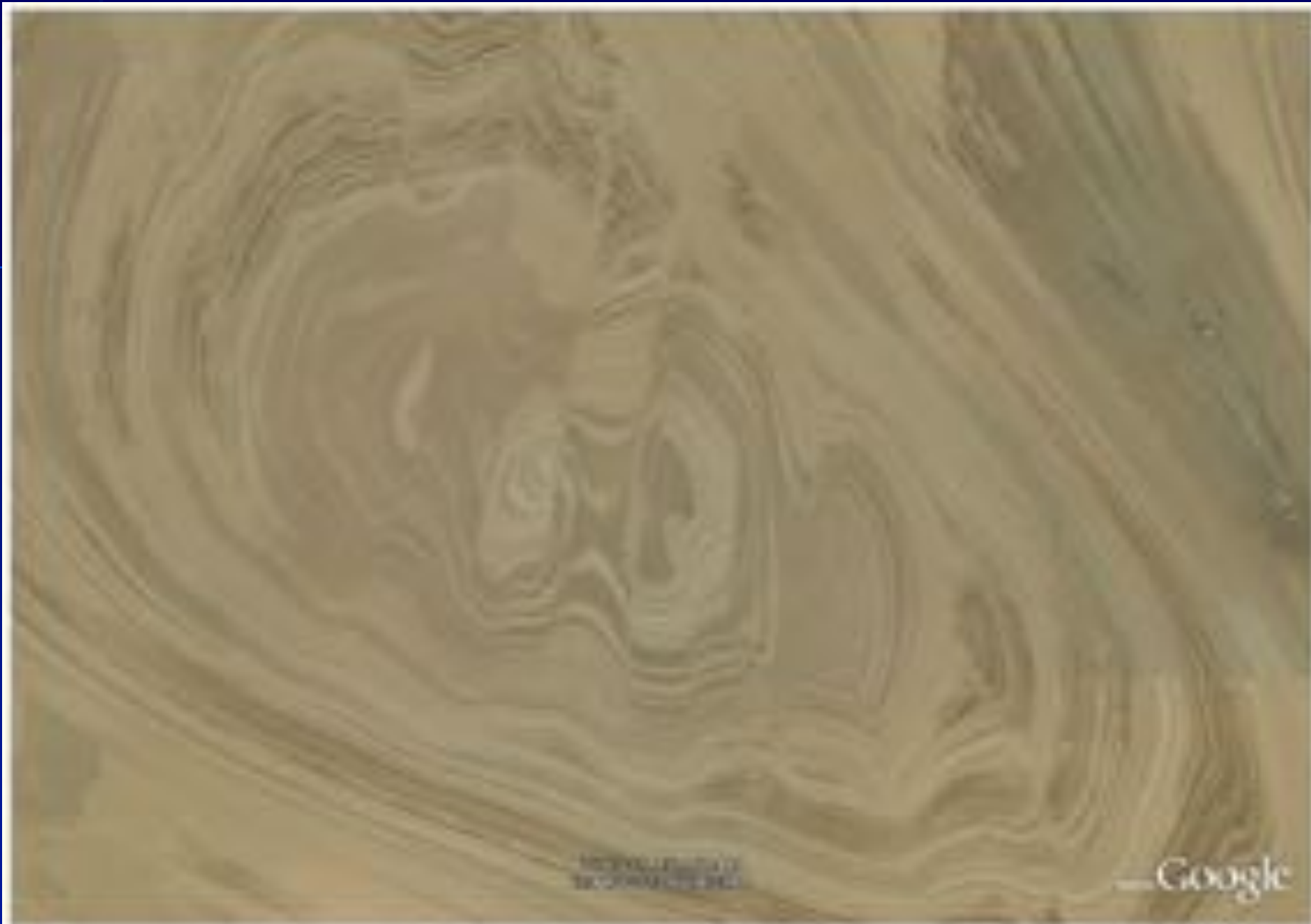


Fig. 4.40 (a, b) Deformation of exposed silt and clay layers in northern Iran at $34^{\circ}38'N$ and $54^{\circ}07'E$ and $34^{\circ}52'N$ and $53^{\circ}47'E$. Width of scene is approximately 6 km (Image credit: ©Google earth 2012)



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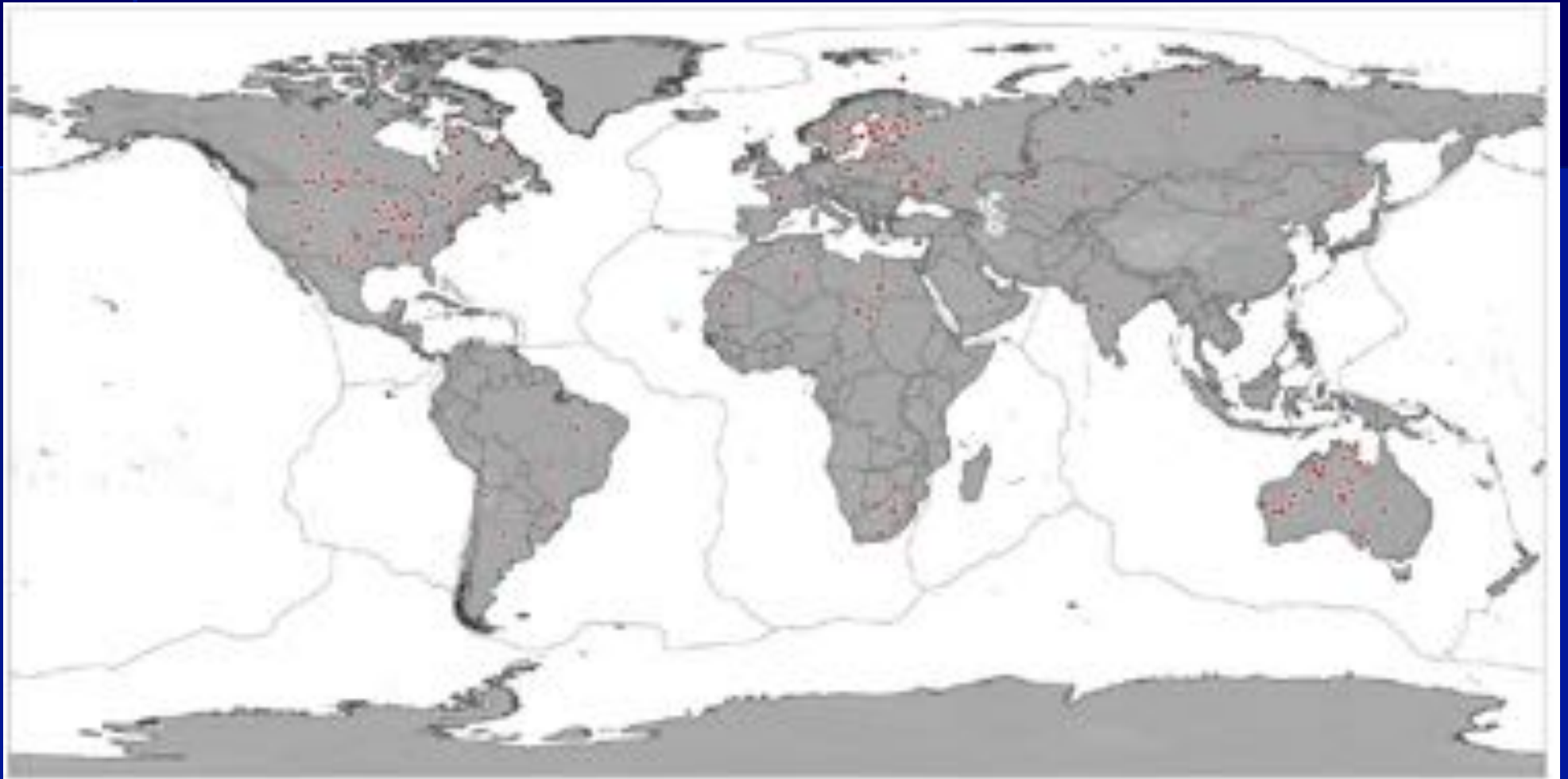


Fig. 5.1 Confirmed impact craters on the continental landmasses of the Earth based on the Earth Impact Database (URL: <http://www.passc.net/EarthImpactDatabase/>)



Fig. 9-2 The Meteor or Barringer Crater in northern Arizona (USA) is the best preserved crater on Earth with a diameter of 1.2 km and a depth of 170 m. It has been formed about 49,000 years ago when an iron-nickel meteorite with a diameter of approximately 50 m and a weight of 300,000 tons travelling at 11 km/s struck the ground. During the explo-

sion (believed to be equal to about 30 megatons of TNT) the sandstone and limestone rock formations were heat upwards to form the outer ring. Impacts of this size statistically occur on Earth every 1,000 years (Image credit: Google earth 2012)

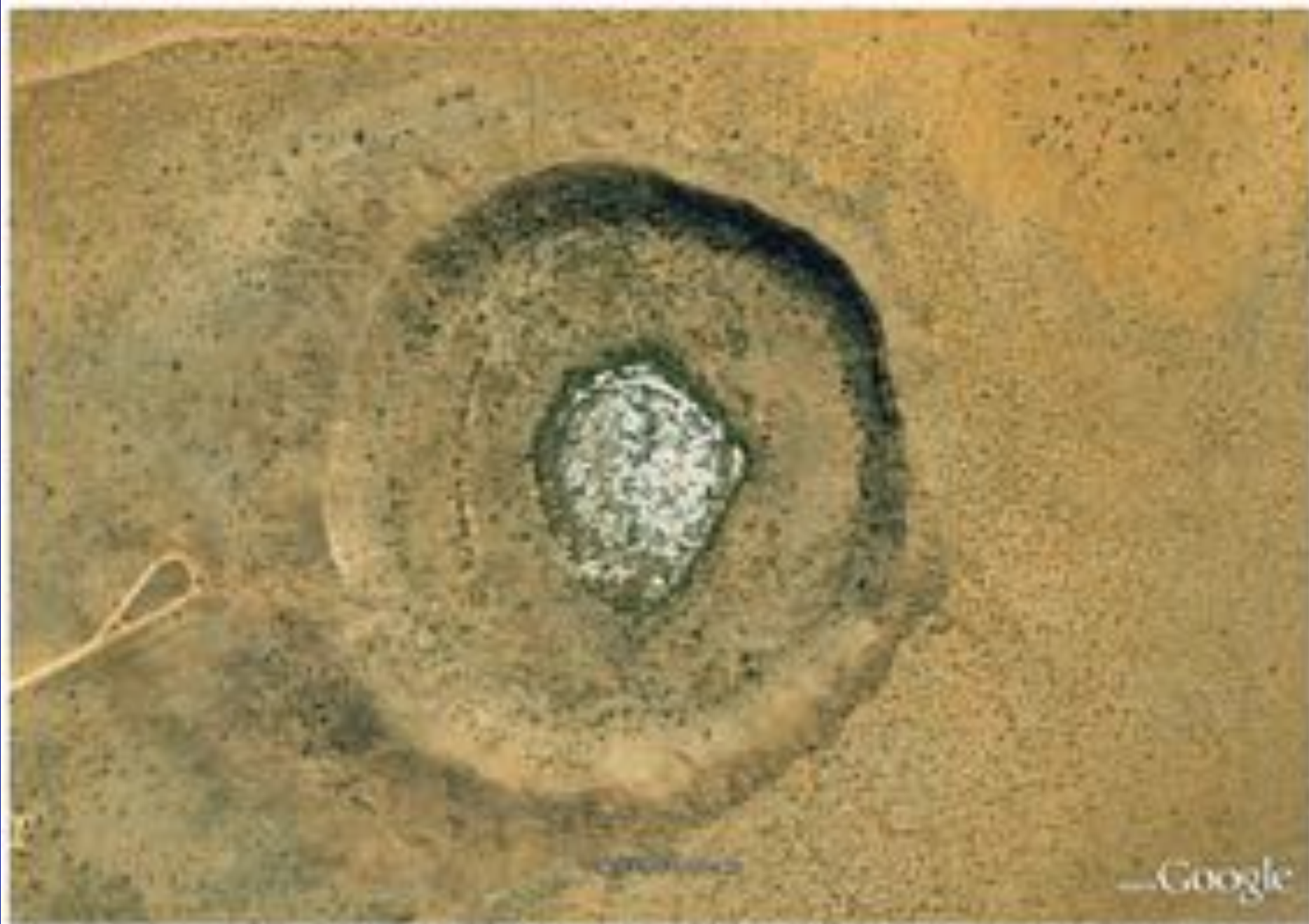


Fig. 5.3 Wolfe Creek Crater in Western Australia at about 29°10'S and 121°47'E. Diameter is 375 m with a depth of 60 m. The impactor is estimated to have had a weight of 50,000 tons of iron and nickel striking

the ground at about 15 km/s. The age of the crater has been determined to be around 300,000 years (source credit: ©Google earth 2012).



Fig. 5.4 Etosha Pan crater in Namibia at 27°47'E and 30°37'E with a diameter of 2.5 km, depth of 130 m and an age of 3.7 million years. It exhibits a perfect round form in very old grass but has been filled by

drifting sand in the desert environment and will possibly be covered in the near future. Melt breccias found in the rim are strong evidence for an extraterrestrial impact (Image credit: ©Google earth 2012)



Fig. 1.5 The superbly preserved Tezomoc crater in Mexico, south-west Africa, at about 27°31'N and 107°24'W has an age of only 22,000 years. The site is composed of very old Proterozoic rocks. The

diameter is around 1.9 km and its depth near 110 m, making the likely size of the impactor 200 m across or more (image credit: ©Google earth 2012)



Fig. 5.4 The Milly Way crater field in central Australia (Northern Territory). Aboriginal oral traditions about the crater field are sacred and secret to outsiders as well as other cultural knowledge about the physical world. The interested reader may refer to the excellent blog of Dr. Diane Hamacher (URL: <http://aboriginalastro.com/blogspot.com.au/>). Hamacher (2012) highlights an aboriginal oral story from the central desert regarding its cosmic origins closely parallels the scientific explanation: "During the Dreaming, a group of sky-women were danc-

ing as stars in the Milky Way. One of the women grew tired and placed her baby in a wooden basket, called a *tarna*. As the women continued dancing, the *tarna* fell and plunged into the earth. The baby fell and was covered by the *tarna*, which forced the rocks upward, forming the circular mountain range. The baby's mother, the Evening Star, and father, the Morning Star, continue to search for their baby to this day" (Image credit: ©Google earth 2012)

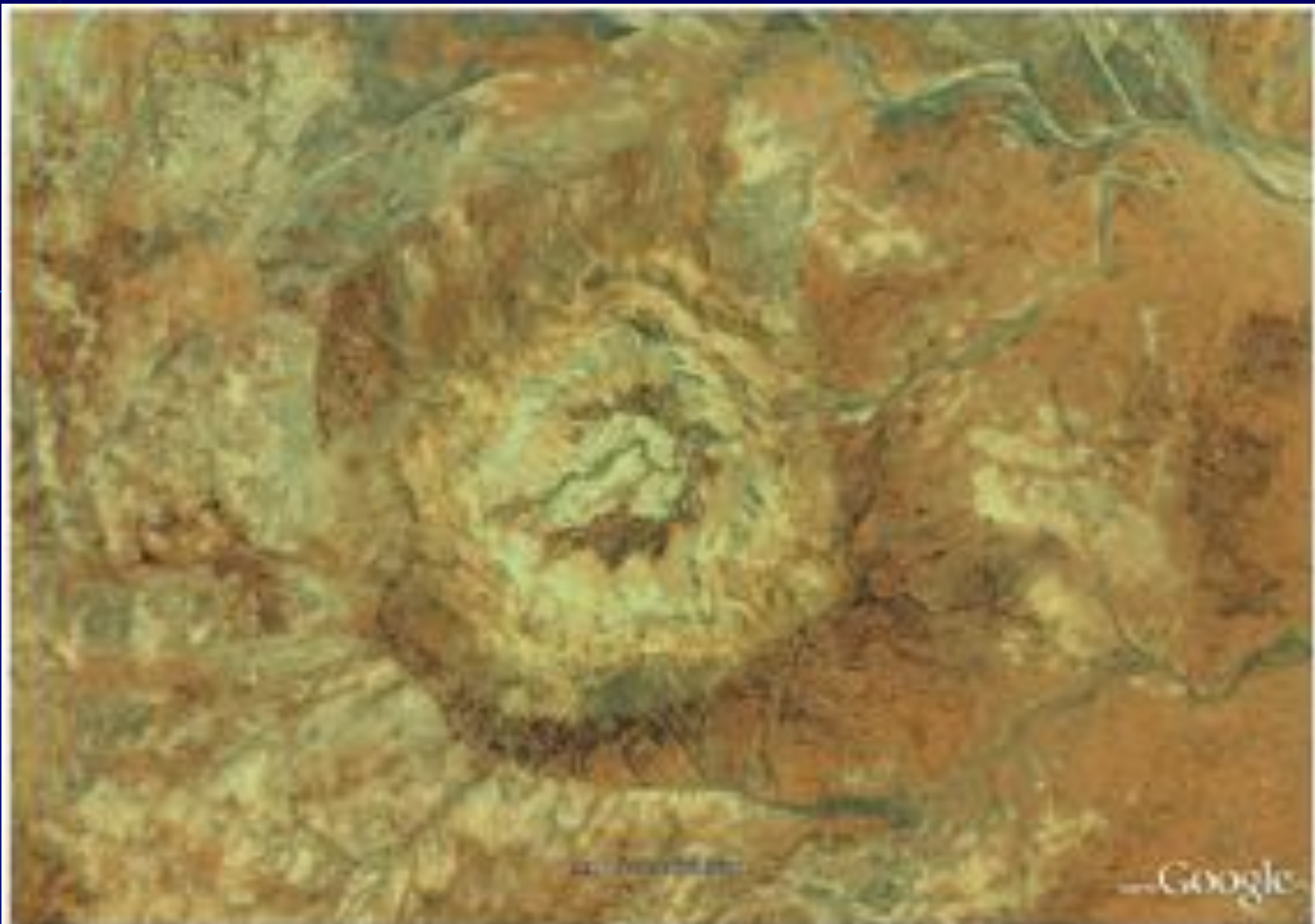


Fig. 5.7 Gosses Bluff impact crater in central Australia (Northern Territory) at $23^{\circ}49'S$ and $132^{\circ}18'E$ with a diameter of 22 km and a depth of 180 m was formed in less resistant rock which sustained rather strong weathering, relative to its young age in the geological time scale (143 million years old). The meteorite may have had a diameter of

about 1 km and originally caused a crater depth of 1.3 km. Shatter cones are conical fragments present at this site with typical markings produced by shock waves. The energy of the impact has been calculated to equal about 1 million Hiroshima bombs (Image credit: ©Google earth 2012)



Fig. 5.8 In the arid landscape of Australia, several old impact craters have been detected such as the complex Acraman crater in South Australia with its salt lake at $17^{\circ}07'S$ and $137^{\circ}26'E$. The crater has a diameter of originally up to 90 km, but today only a ring-like structure close to 35 km in diameter is visible. Its age has been determined to be

about 590 million years, but strong erosion has changed all original morphology. Shatter cones in the rock and shocked quartz minerals document the strong impact that has been estimated to equal 5.7 million megatons of TNT (image credit: ©Google earth 2012)



Fig. 5.9 The Shoemaker crater in Western Australia, at 23°51'S and 120°54'E with a diameter of about 30 km, belongs to the oldest impact structures on Earth with an estimated age of 1.61 billion years, although more recent measurements yielded a much younger age of only 568 ± 20

million years. Again shatter cones and the occurrence of shocked-quartz document the impact process in Archaean granitic rocks (Image credit: ©Google earth 2012)



Fig. 5.10 The Clearwater impact craters (Quebec, Canada; Clearwater West with a diameter of 36 km, and Clearwater East with a diameter of 26 km) are both located around 50°08'N and 74°22'W. It is thought that

a binary asteroid around 290x20 million years ago hit the Earth. In the smaller crater (Clearwater east) the central bulge is hidden under water (Image credit: ©Google earth 2017)



b



Fig. 214 (a, b) The Westridge crater rim at about 17,000 and 17,400 m consists of basalt with a diameter of 1000 m. The crater floor was primarily formed by an eruption of about 1 km across. The age has been dated as 100,000 years. The rim is also composed

of andesite. The crater rim is also composed of andesite. The crater rim is also composed of andesite. The crater rim is also composed of andesite.



喀斯特地貌





Fig. 7.1 (a) Typical karron features on a limestone rock in Greece. They are about 50 cm long and distinct in shape at the upper parts. Rainwater is acidic and erosive and it becomes increasingly more saturated with soluble carbonate and consequently less erosive as it flows downwards (Image credit: D. Kefelad). (b) Intersecting karron features

tracing different joint patterns in limestone of the Aran Islands, Ireland (Image credit: A. Schiffloni). (c) Karron landscape in the Bulbarra/Gnyrry National Park (Northern Territory, Australia), developed in the carbonate and calcareous rocks of the Proterozoic Skell Creek Formation. A clear rotation of karron formation resulting from



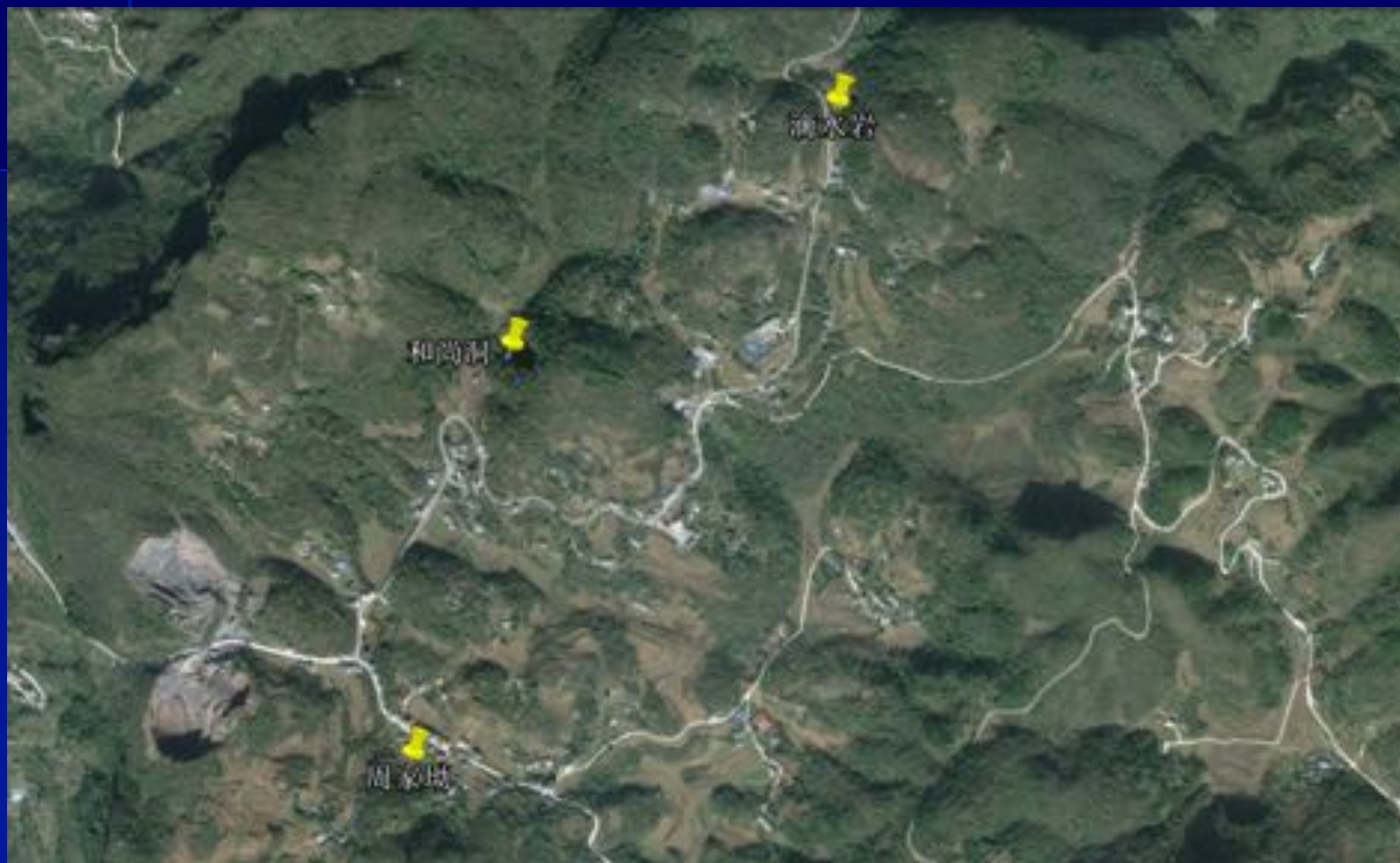
Fig. 1.5. (continued) progressively larger within cholesterol after large cholesterol crystals. The smaller right part of the image shows smaller and smaller cholesterol crystals, whereas the larger right part shows





Fig. 14.8. An aerial view of a forest canopy with a small white clearing in the lower right quadrant. The forest canopy is dense and green, and the clearing is a small, irregular white patch. The image is a composite of two aerial photographs, with the top one showing a larger area and the bottom one showing a closer view of the forest canopy.





块体运动







a





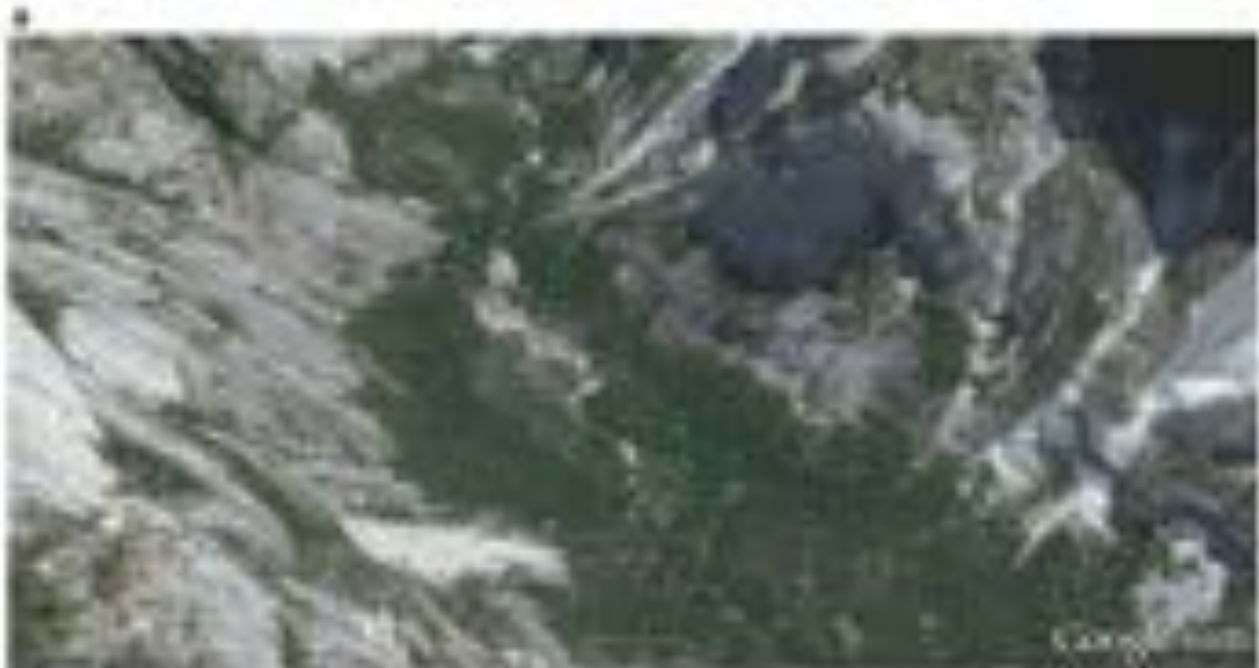


Fig. 4. (a) & (b) are satellite images of the Amazon basin at two different times, a before and after the formation of the Amazon basin. The images show the Amazon basin before (a) January 2000, and after (b) July 2000. The small, large-scale weathering front (indicated) of the granite basement shows the formation of weathering in the area through erosion (a) and (b).

c

Fig. 8.3 (continued) and lobate deposits in the upper and lower parts of the cones, respectively. (b) Talus cones in the Southern Alps of New Zealand (upper Rakaiia Valley, at $45^{\circ}36'1.22''S$, $170^{\circ}58'41.61''E$). The typical sorting pattern with larger blocks in the lower, distal part of the talus cone is visible. (c) Talus cones (right) and lateral moraines (left)

south of Bow Lake, Banff National Park, Canadian Rocky Mountains ($51^{\circ}39'55.29''N$, $116^{\circ}27'29.96''W$). In addition to the rockfall material, debris flows may develop from the talus cones due to water saturation of rock debris sections (Image credit: ©Google earth 2012)



Fig. 8.61. Ice formation and flow during the winter of a tributary glacier in the Cordillera Occidental. The natural channel from the glacier also has an edge of melting that separates areas in contrast to several days when water is the face of the water table. The large water deposit formed during an

unseasonable. The size of the large mountain is clearly visible in the image. By 1995, according to the United States Geological Survey, with the glacier at its peak, the large water deposit could reach 100 m



Fig. 8.8 View of the 'Val' High rock outcrops (Tahitihaia, 1999), which occurred on July 1996, 1997. It destroyed the villages of 'A. Aotoua, Mungarua and Tereu. The heavy rainfall and erosion global erosion of debris deposits by the 'Val' High River caused a shallow slope failure and the erosion of more than 10 million m³ rock debris material. Typically,

the most vulnerable natural slopes the initial debris deposits were followed by debris slides, debris flows, and a mud flow. The failure caused by the rupture of a temporary lake which had formed by damming of the river through a debris flow (Copyright 2010).





Image © 2012 DigitalGlobe

Google earth

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松散物质的运动



Fig. 8.8 Satellite images of the Great Sand Sea, Libya. The top image is a satellite image of the Great Sand Sea, Libya, showing the vast expanse of sand dunes and a small oasis with palm trees. The bottom image is a satellite image of the Great Sand Sea, Libya, showing a complex network of sand dunes and a large, dark, irregularly shaped area that appears to be a salt flat or a different geological formation. The images were obtained by Google Earth on November 1st, 2011, using the satellite imagery from the Landsat 5 satellite and the Landsat 7 satellite.

ing of a glacier in the Great Sand Sea, Libya. The top image is a satellite image of the Great Sand Sea, Libya, showing the vast expanse of sand dunes and a small oasis with palm trees. The bottom image is a satellite image of the Great Sand Sea, Libya, showing a complex network of sand dunes and a large, dark, irregularly shaped area that appears to be a salt flat or a different geological formation. The images were obtained by Google Earth on November 1st, 2011, using the satellite imagery from the Landsat 5 satellite and the Landsat 7 satellite.



Fig. 8.10 (a, b) If saturated by water, the friction between particles or smaller fragments is lowered. Locations of debris cones or debris accumulations on the higher slopes may become unstable and start to flow downhill under the force of gravity, resulting in a debris flow. Though containing larger volumes of sediment, debris flows may flow very flu-

idly. The images show typical associated scarps with accompanying ridges on alluvial fans in northwest Argentina (27°07'N, 67°27'W) where debris flows are characteristic (Image credit: ©Google earth 2012)





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Image © 2017 CNRS / Airbus
Map © 2017 CNRS / Airbus

Google earth

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河流地貌







Fig. 8.2. (a) Confluence of the Negro ("Black River") and the Amazon River near Manaus, Brazil. The water from the Amazon main channel and a number of tributaries comes from the south, as indicated by a light-colored suspension zone. (b) Detail of the confluence channel where the Amazon (clearer) the Negro and a su-

per-Amazonian tributary, all flow in clear turbid water, and channel contraction is in the Amazon side (also "Black River channel"). Considerable differences in the density of the two water bodies is a sign of the water for easy detection. (Source: Google Earth 2010)





The left is a braided channel system, which is a type of channel that is characterized by a network of interconnected channels that frequently change course. The right is a meandering channel, which is a type of channel that is characterized by a single channel that winds back and forth in a series of loops.



Fig. 6.10 (a) The Grand Canyon of the Yellowstone River in northern Idaho (1140 m above sea level) is approximately 1.6 km deep and 20 km wide. (b) Close-up view of steep and relatively steep sections of strata in the west wall of the east canyon, illustrating sedimentation. The horizontal layering shows good layering (width, 1.60 km). (c) The Grand Canyon of the Yellowstone River, Idaho (1140 m above sea level).





Fig. 4.18 (a) View of road built through with a perfect example of how the construction crew took. Another view, 02/01/07 and 02/02/07, to show the construction along the inner banks of the meandering, French River at French, west of the Twin Mountains

02/02/06 and 02/02/07. High flow velocities occur along the outer embankment to the east bank of the meander. Small stream cross-sections occur (Image credit: Google Earth 02/02/07).



Fig. 8.15 Obital from the middle section of the Mississippi River at $33^{\circ}23'N$ and $90^{\circ}47'W$. The meander shown here (at center left) is about 1 km wide (image credit: ©Google earth 2011)

a



b



c





Fig. 10.10 (a) and (b) show the river banks under the same flow conditions (equal) with slight variations in the opposite side of the river flow. In (a), the river banks are slightly higher, the degradation of the banks is more pronounced along the outer bank (right side) and the degradation of the inner bank is less. In (b), the river banks are slightly lower, the degradation of the banks is more pronounced along the inner bank (left side) and the degradation of the outer bank is less. This shows the flow is slightly higher, causing increased bank erosion.

erosion and sedimentation. The meandering river through the river bank will be eroded on the bank and the old channel will be abandoned to form an oxbow lake (see also Fig. 10.11). The meandering river flow is caused by the flow of the river through the river bank and the river bank is eroded on the inner bank. The flow of the river is caused by the flow of the river through the river bank and the river bank is eroded on the inner bank. The flow of the river is caused by the flow of the river through the river bank and the river bank is eroded on the inner bank.







Fig. 1.22 (a) Tulum valley with lower reaches of the San Pedro river (see Fig. 1.21). A volcanic cone is visible to the southeast and yellow clay deposits of ash fall are visible. (b) Another view of the Tulum valley (see Fig. 1.21). The valley is bounded to the north by volcanic flow cones and debris fans. The lower parts of the hills are forested to the east and west of the valley (see Fig. 1.21). (c) Another view of the Tulum valley.

(Continued on this slide) (See Fig. 1.21, continued) (a) Another view of the Tulum valley (see Fig. 1.21). The valley is bounded to the north by volcanic flow cones and debris fans. The lower parts of the hills are forested to the east and west of the valley (see Fig. 1.21). (c) Another view of the Tulum valley.





Fig. 4.27 (a) Google satellite view of the Grand Valley National Park, California, USA. The large hole at the bottom of the image is clearly filled with ash and is outlined here indicating a cinder cone. Typical features of such a hole in the desert (such as circular channels, volcanic deposits, etc.) are all illustrated and identified, showing the view from above. (b) The western part of the Grand Valley showing extensive alluvial fan systems originating from the surrounding mountain chains. The fan bases (indicated here as green) together normally deposit typical volcanic material in greater (orange) levels (through cone 2017). (c) Photo of a similar eruption in the Grand Valley. (d) All (b) (c)

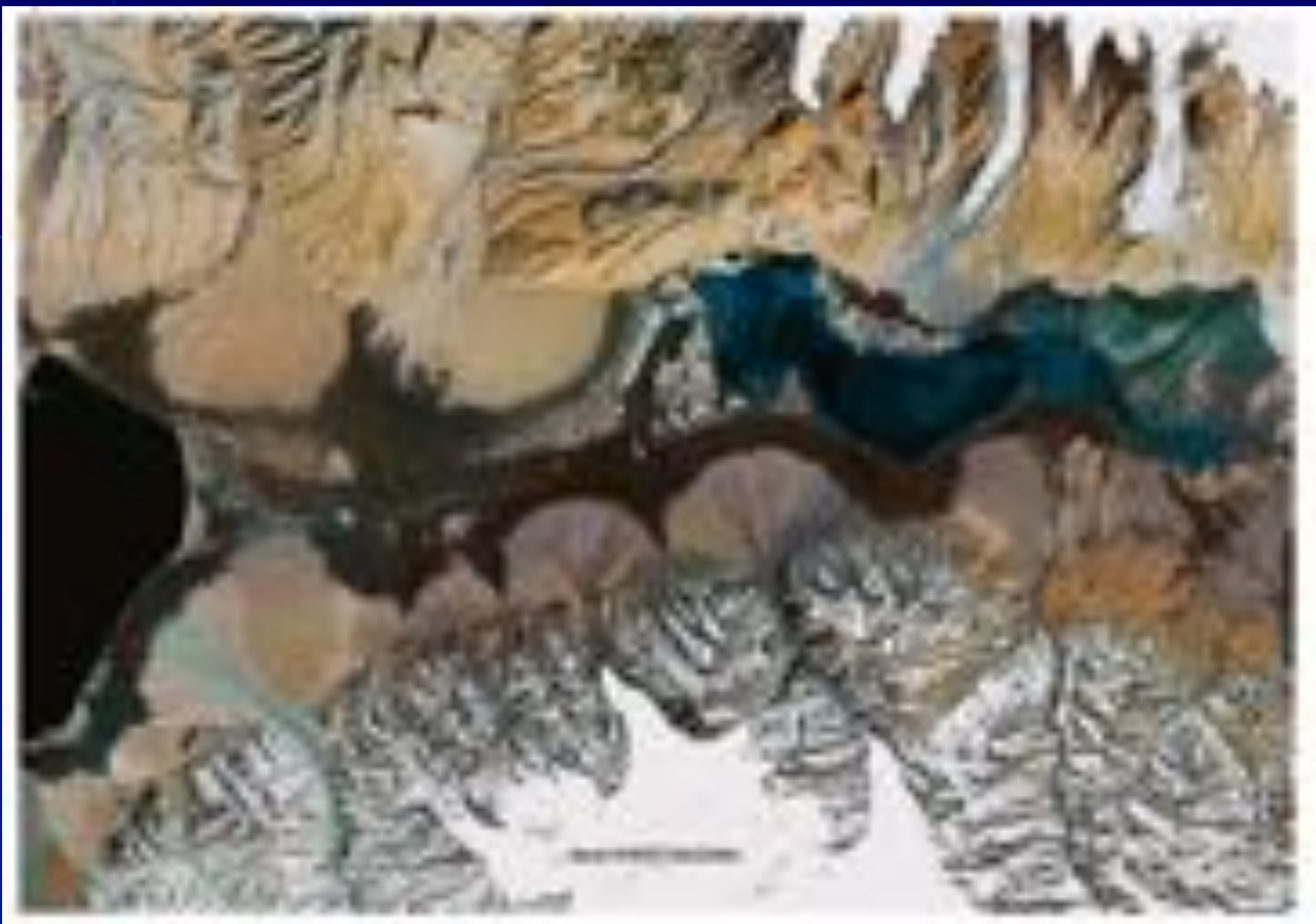




Fig. 8.22 (a-c) Oblique views in orientation of the Great Basin in California National Park of rock cirques, demonstrating the high cirque walls in the center of granite dome which will erode the peaks and which are extremely common in the Sierra Nevada and in the Sierra Nevada range from the 18th May to the 18th June.



Fig. 8.26 (a) An aerial view of the Victoria Falls, which is one of the largest waterfalls in the world. The water falls over the edge of the cliff and cascades down into a pool of water below. The surrounding landscape is lush green. (b) A close-up view of the Victoria Falls, showing the water cascading down the edge of the cliff. The water is white and foamy, and the surrounding landscape is lush green. (Images credit: Shutterstock.com)





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风成地貌

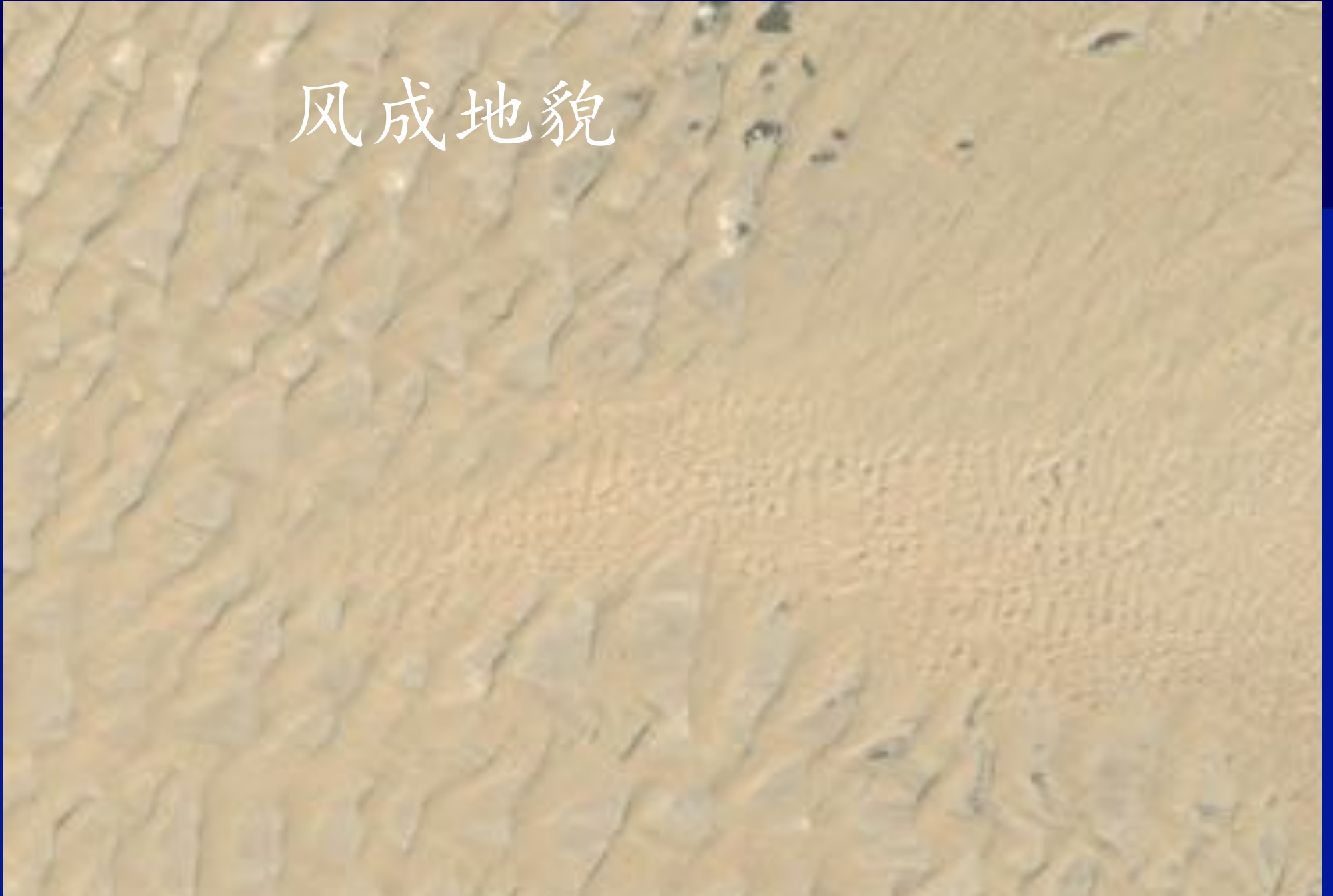




Fig. 81.4 (a) Wind may sculpture and polish rocks in the area above abandonment levels (and therefore is likely to be felt). The example is from northern Spain, a position inland, where is

some of the highest in the windy region. The rock is predominantly composed of hard basalt. As wind increasingly, wind gains close to the surface, grains that abrade the steep rock surface.



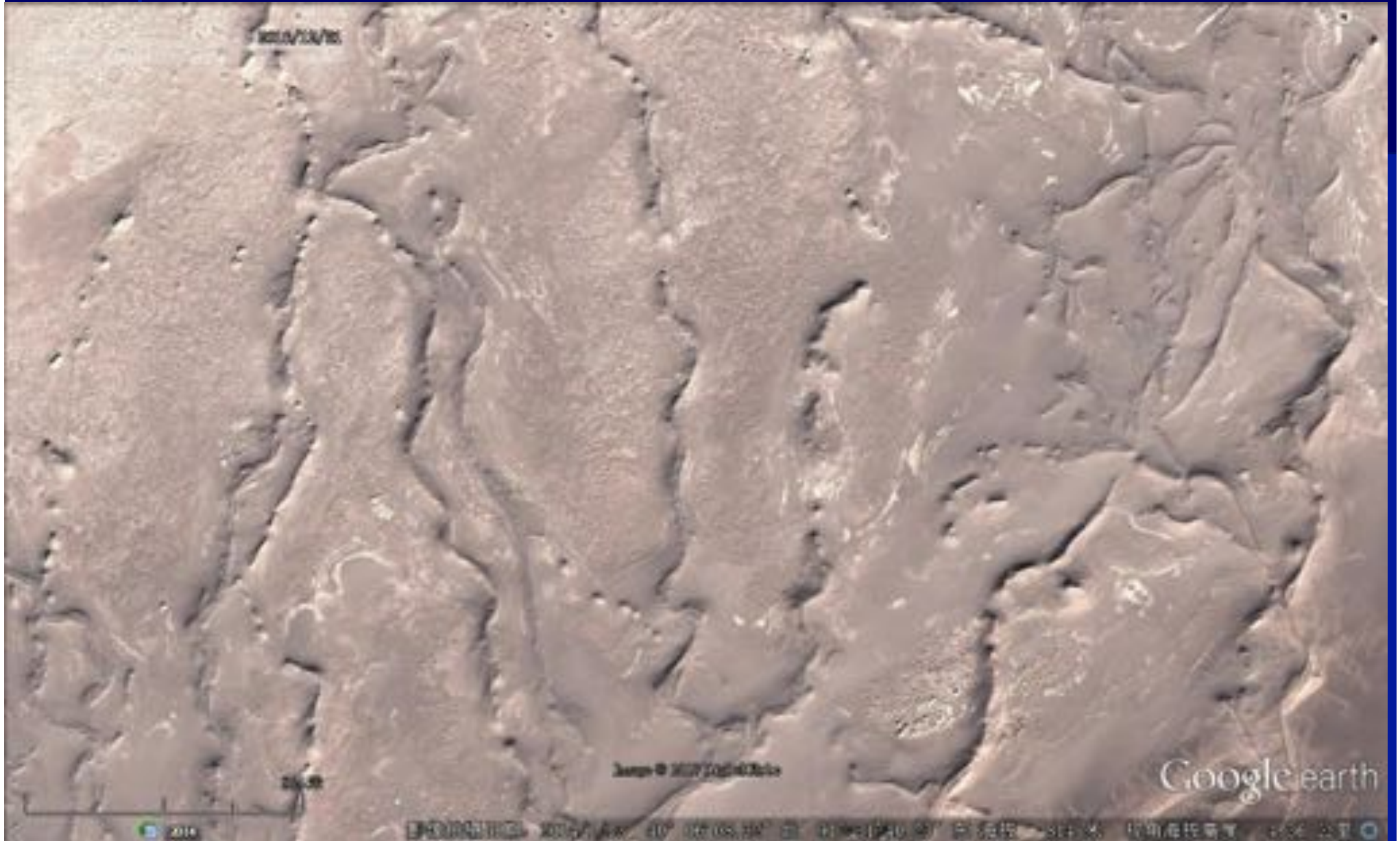




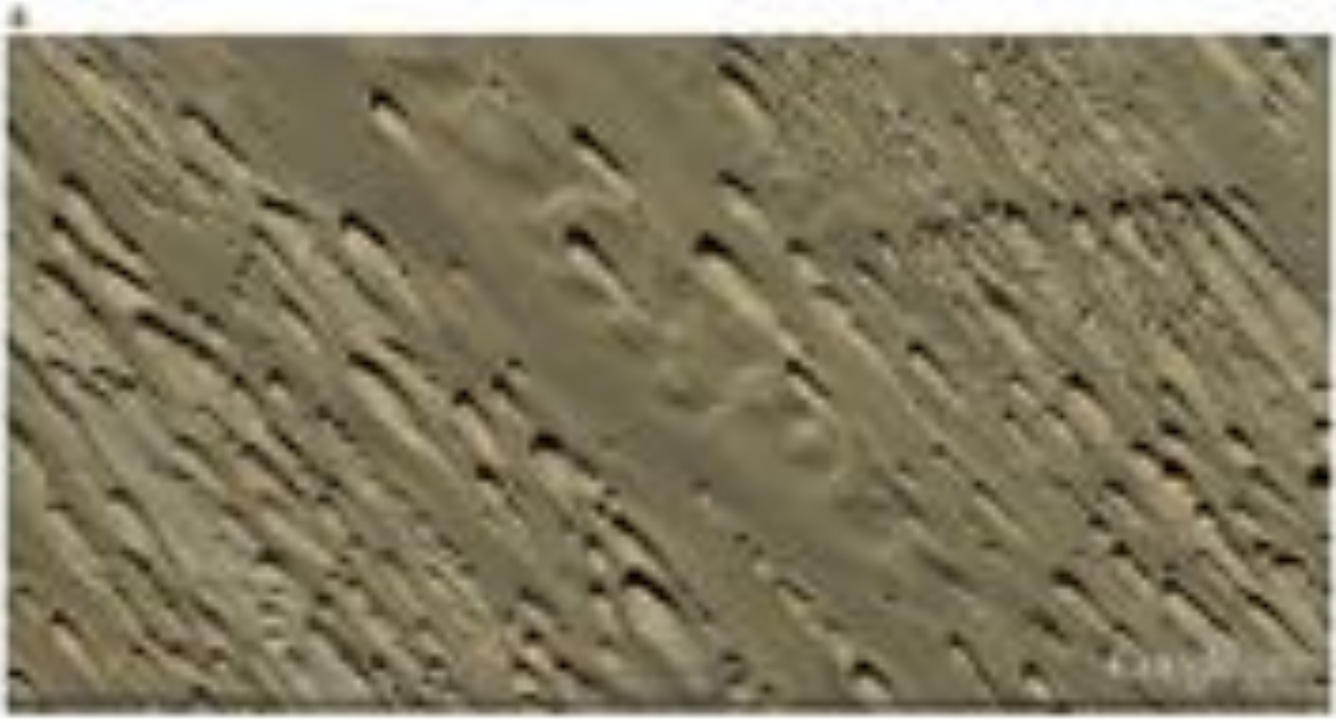
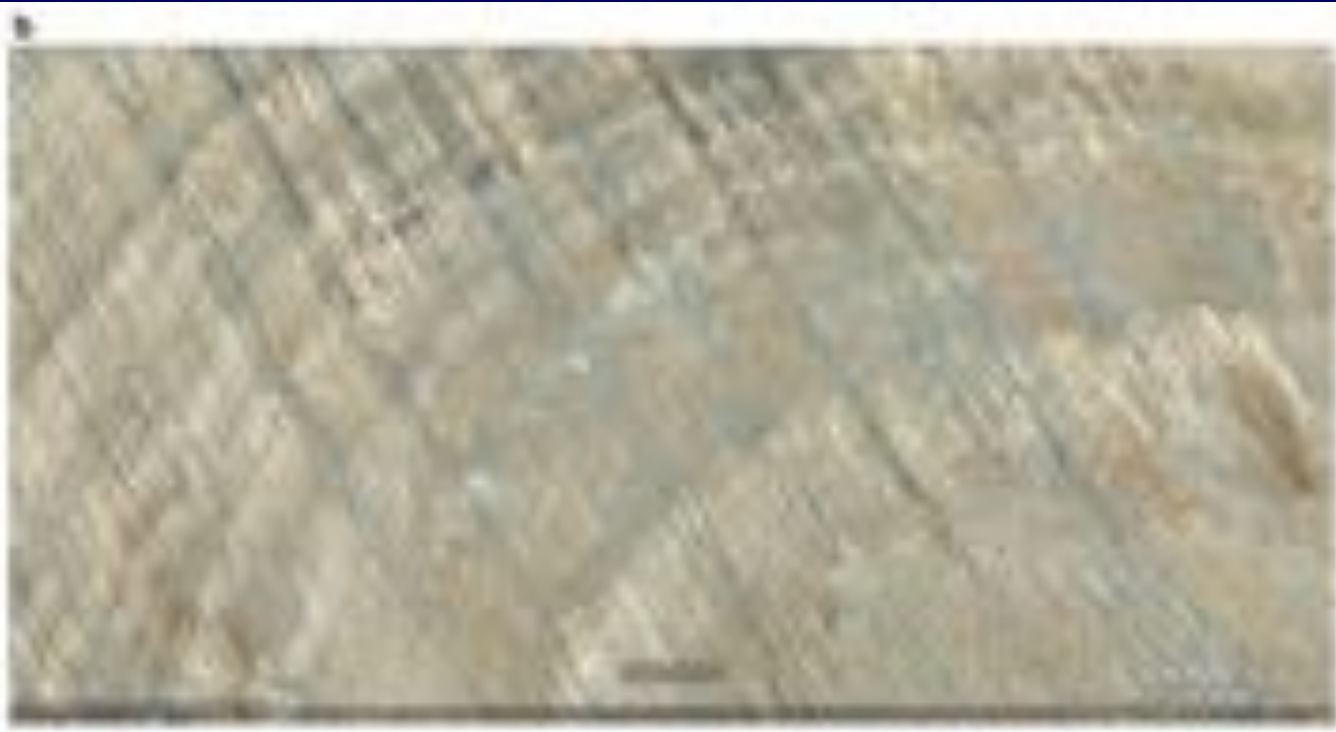
Fig. 11.8 (a) Long, narrow, and slightly curved structure, likely a nematode, with a distinct head region and a tail region. (b) Similar structure to (a), but with a more pronounced, dense, and somewhat irregular appearance, possibly indicating a different developmental stage or a different part of the organism.



Fig. 10.11 (a) Aerial view of the sand dunes of the Thar Desert, Rajasthan, India.



Fig. 10.11 (b) Aerial view of the sand dunes of the Thar Desert, Rajasthan, India. The dunes are formed by the wind-blown sand from the Thar Desert, Rajasthan, India. The dunes are formed by the wind-blown sand from the Thar Desert, Rajasthan, India.





4





Fig. 11.8 (a) A single barchan dune in Nevada, suggesting that sand is more plentiful in the east (northern area). Windward dunes are larger (about double) of the leeward dunes in 1974. (b) Barchan dunes along the Nevada-Southwest border in 1974. The dunes are about 100 m long and 10 m high. A scale bar is shown in the lower right corner of the image. (c) Aerial view of a field of barchan dunes in the southern Nevada, between 37°30'N, 115°15'W and 37°45'N, 115°15'W.

Barchan dunes are growing together in some places in Nevada (c), suggesting that wind is less plentiful in the west. (d) Aerial view of a field of barchan dunes in the Nevada-Southwest border in 1974. The dunes are about 100 m long and 10 m high. A scale bar is shown in the lower right corner of the image. (e) Aerial view of a field of barchan dunes in the Nevada-Southwest border in 1974. The dunes are about 100 m long and 10 m high. A scale bar is shown in the lower right corner of the image.



Fig. 11.16 (continued)

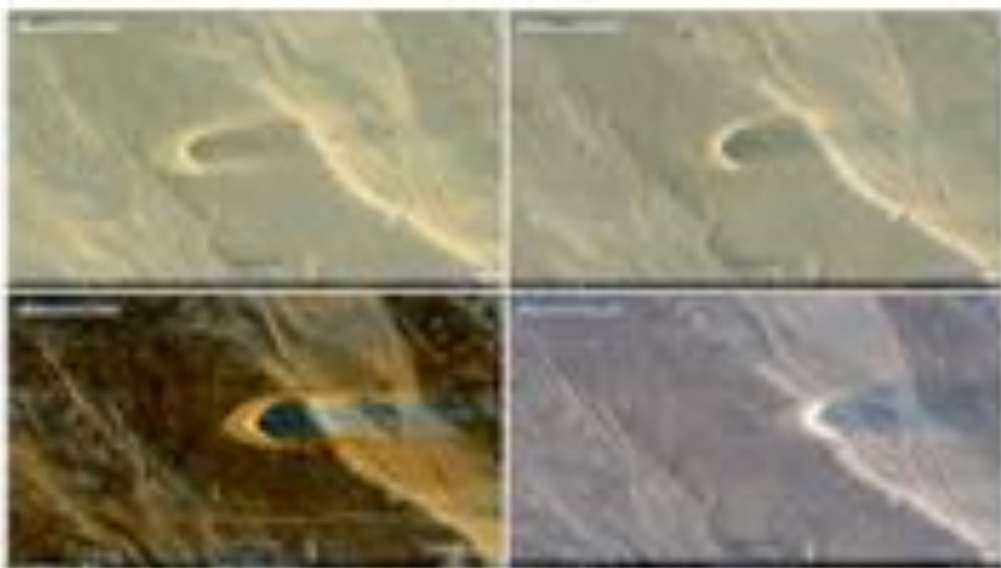


Fig. 11.17 In single and ringed bacteria, nuclei are visible (arrows) (10000x and 40000x, respectively) at their characteristic position in their structure, and electron micrographs (arrows) indicate the position of nuclei. Scale bars are indicated in micrometers. Width of these panels is ~10 μ m.

Additional features suggesting bacterial nuclei are present in the electron micrographs, suggesting that the larger dark spots in the micrographs (arrows) could be larger nuclei.





Fig. 11.18 (a) is a micrograph showing the surface of a metal specimen after being polished with a fine diamond paste. The surface shows a fine, regular texture. The white feature is a defect in the metal. This defect, the surface was identified by optical microscopy. (b) is a high-magnification micrograph of the same specimen showing the surface after being polished with a fine diamond paste.

(b) is a high-magnification micrograph showing the surface of a metal specimen after being polished with a fine diamond paste. The surface shows a fine, regular texture. The white feature is a defect in the metal. This defect, the surface was identified by optical microscopy. (b) is a high-magnification micrograph of the same specimen showing the surface after being polished with a fine diamond paste.

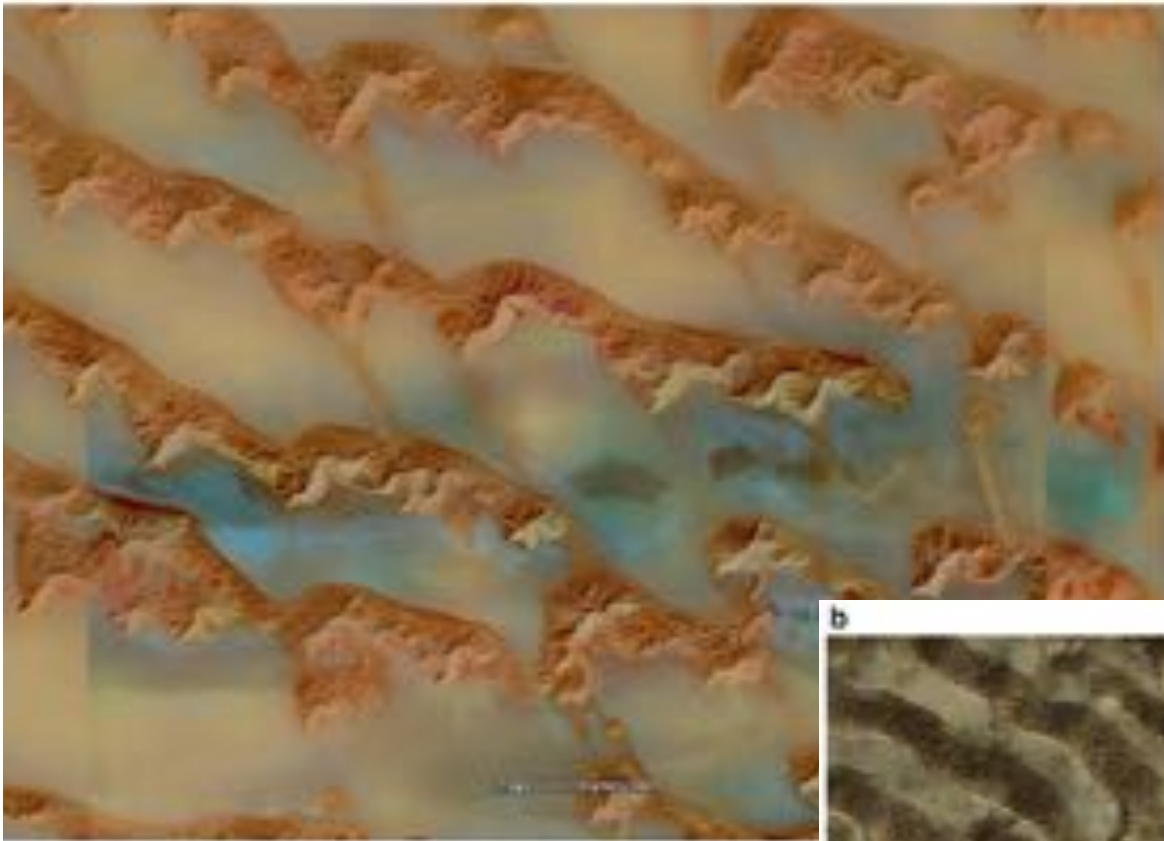
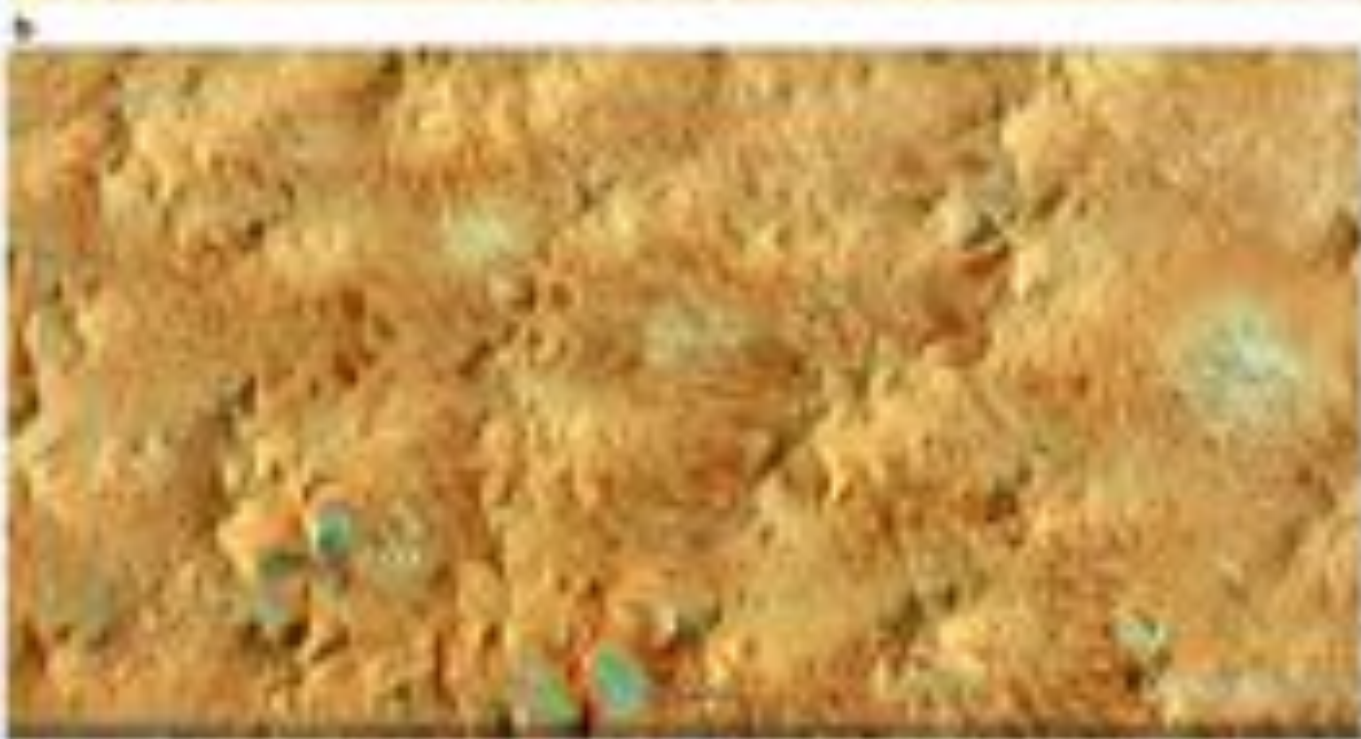


Figure 11.17 (a) In the eastern part of Saudi Arabia at around 57°N and 34°09'E, barchanoid dunes form a network of megadunes over more than 30,000 km². This image shows a section 70 km long. Northerly winds have transported the sand in the direction of the Empty Quarter in the Arab

more than 100 m high and a star dunes. (b) Flat-topped, star dunes around 37°01'N and 51°57'E

b





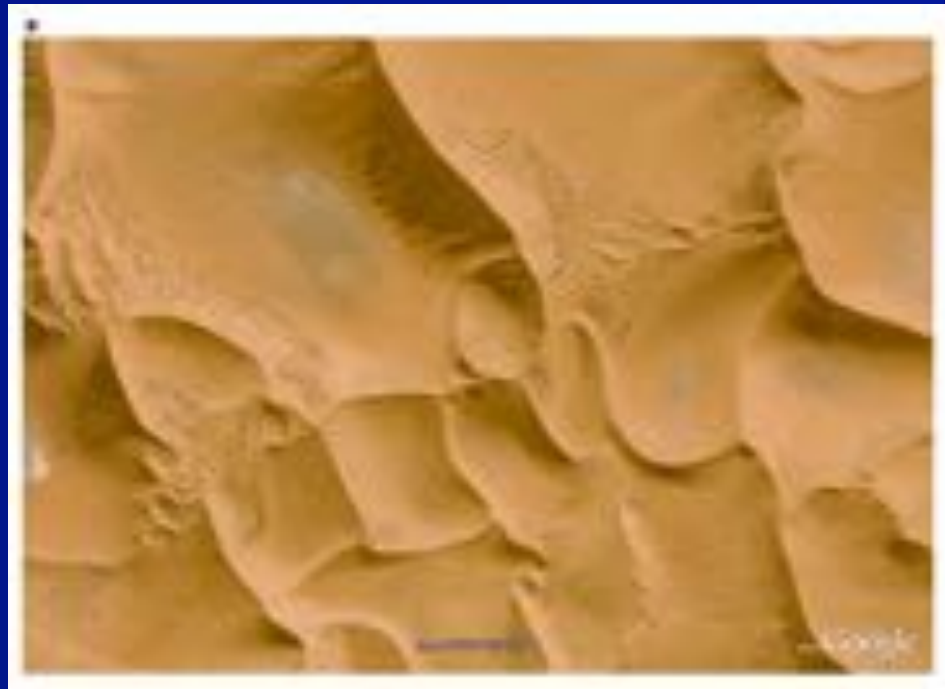




Fig. 14.26 (a) The image shows a coastal area with a large, light-colored area, possibly a sandbar or a large field, adjacent to a body of water. (b) The image shows a similar coastal area, but with a prominent, dark, winding feature, likely a road or a drainage ditch, cutting through the light-colored terrain.

冰川地貌





Fig. 12.3 (a) A series of different snowfalls from one winter is preserved on an alpine pass. Each darker season represents a phase of being, where snow disappeared but other particles have been carried into the remains of the old snow. Similar records are developed in a far manner in glacial ice over much longer time periods (Image

credit: D. Kallweit). (b) The 670 Swiss Alps (46°20'N, 8°26'E) in body of ice, which represent a flow and detritus within the snow air credit: ©Google earth 2012)

b





Fig. 12.2 Ice crystals from an alpine valley glacier, grown together with a diameter of up to more than 10 cm each. White tiny spots in the left upper part of the image are small bubbles of air in the ice (image credit: D. Kollweyer)

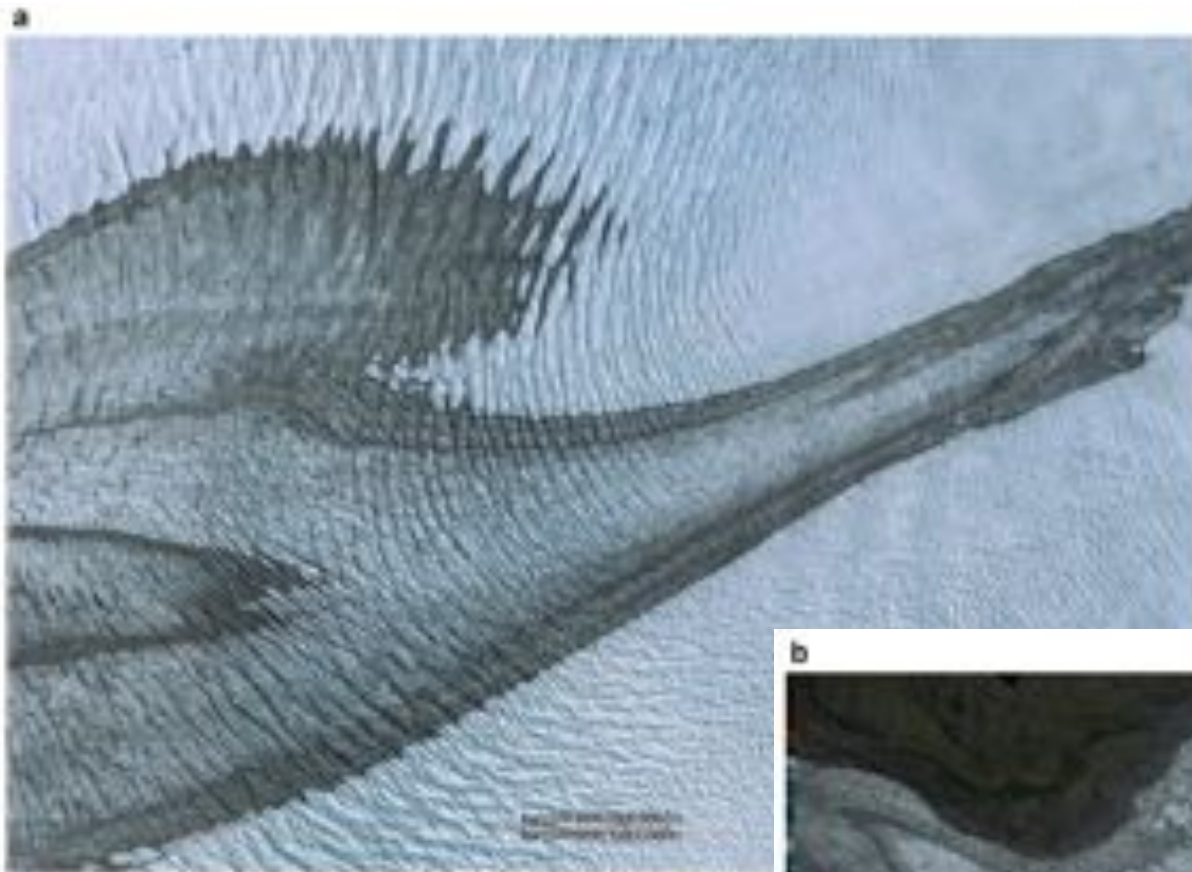
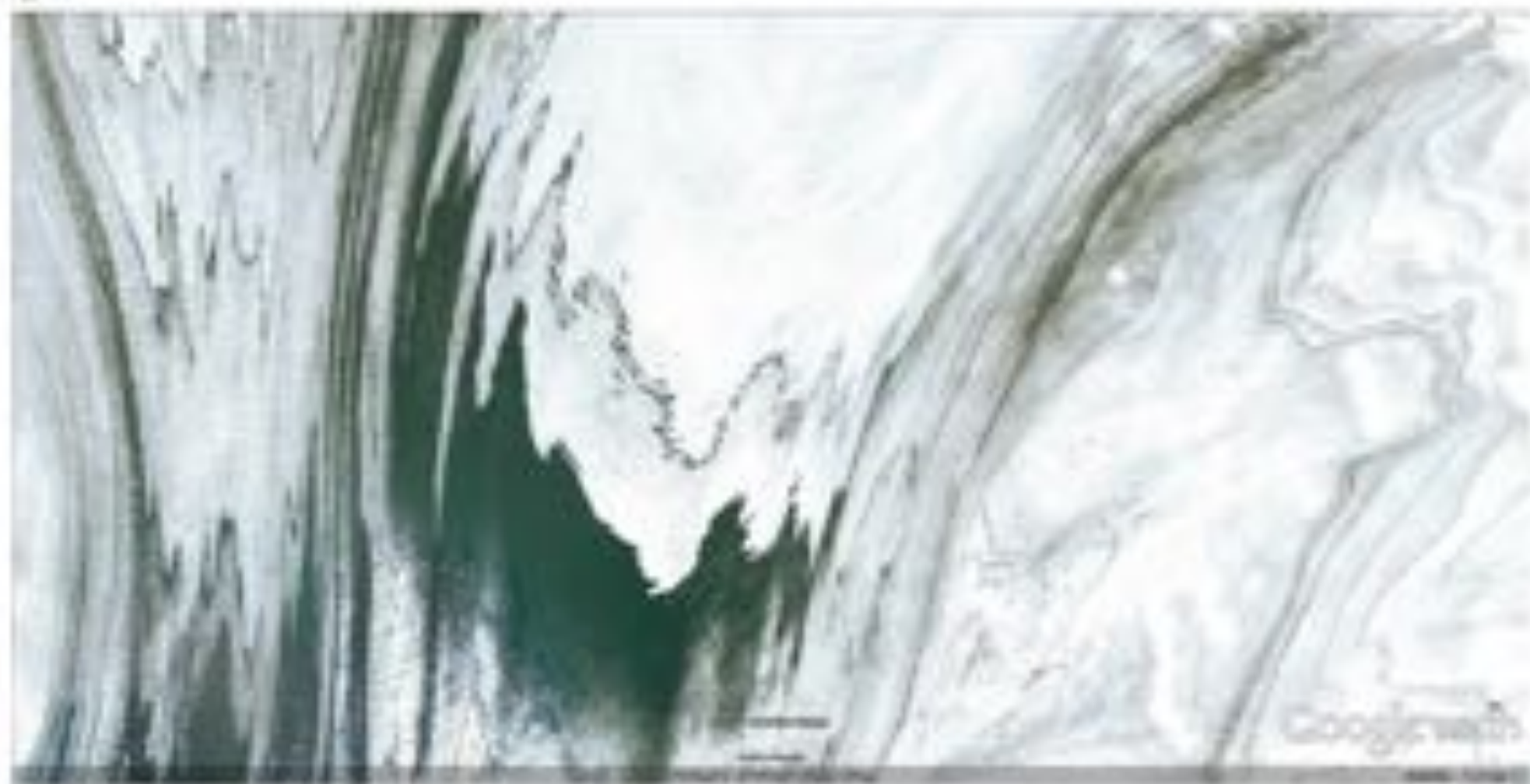


Fig. 12.3 (a) Dirty layers on the Chilean glacier are particles from volcanic eruptions, like tuff, ash and cinder. These may derive from a single eruption with different rhythms and therefore show material of different grain size. (b) In this Chilean glacier tongue the dirty layers from volcanic eruptions are defined layers even parts of the glacier ©Google earth 201



a



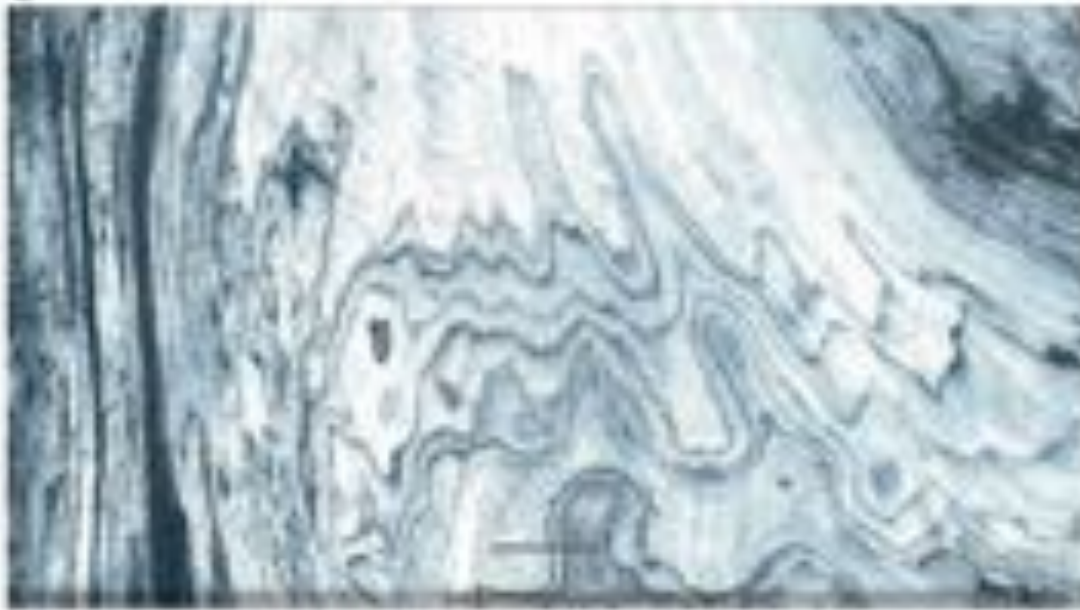
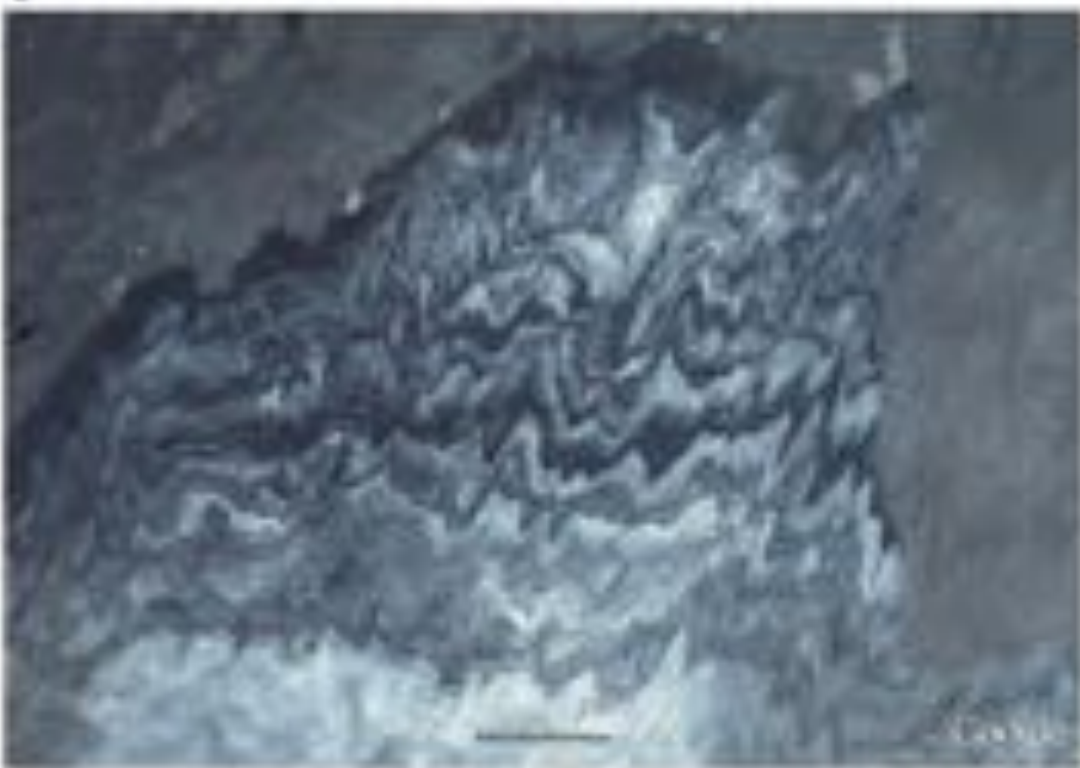


Fig. 124 continued



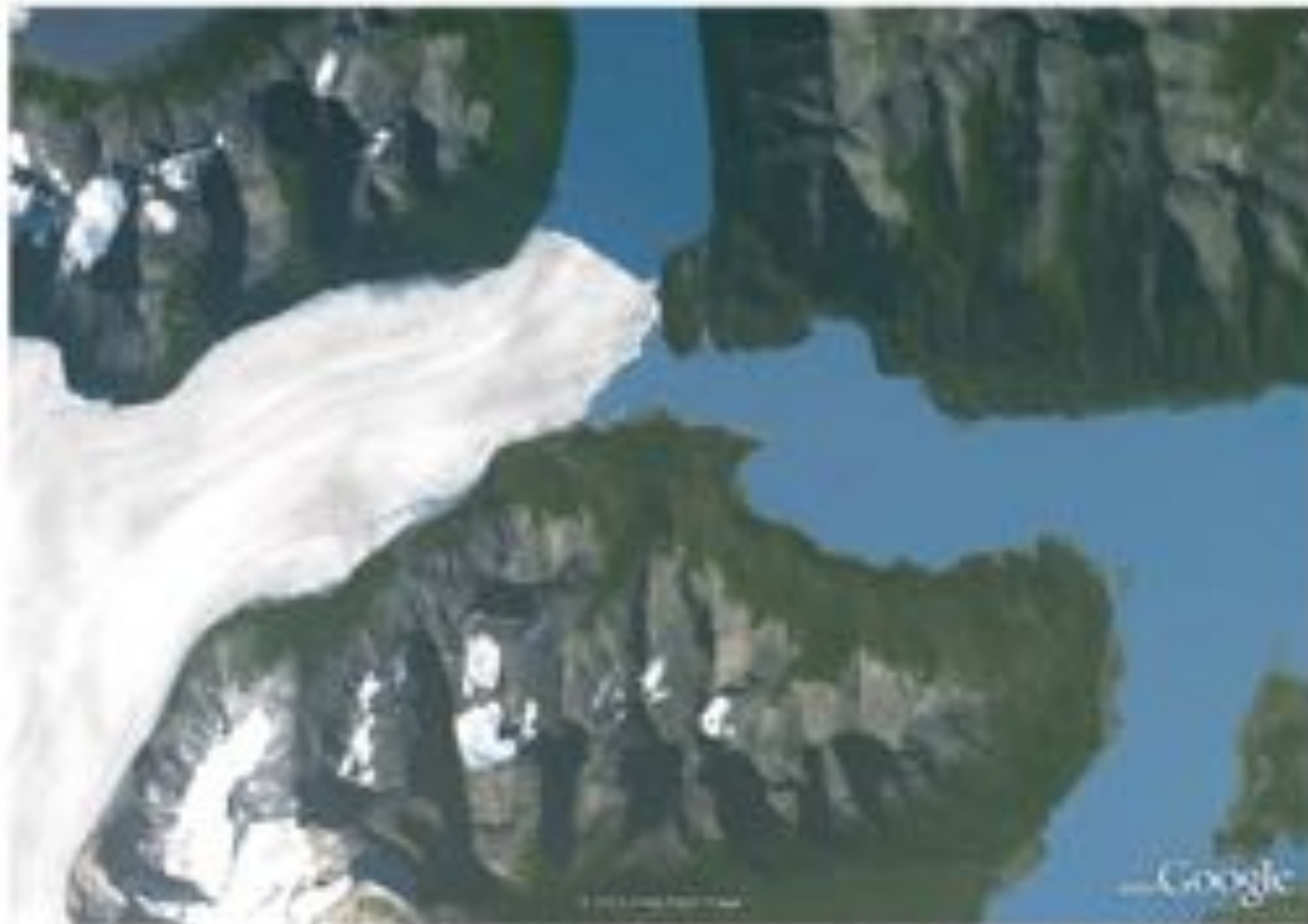
a

Fig. 13.5 (a) The famous Perito Moreno Glacier in southern Patagonia (Argentina) at 50°28'S and 73°01'W with a tongue nearly 3 km wide. The glacier oscillates within several years and closes the eastern section of Lago Argentino. As a consequence, lake water is stored up to about 20 m higher than in the northern part, and the glacial tongue may flow and break. From time to time, the southern lake bursts out. The satellite

image shows a small human boat along the lake on the right part of the image, which marks the maximum high water line without regression (Image credit: ©Google earth 2012). (b) Northern part of the tongue of the Perito Moreno Glacier calving into Lago Argentino (Image credit: ©Katharine)

b



a

Fig. 12.6 (a) San Quintin Glacier (southern Chile) calving into its terminal lake. (b, c) Glaciers from the Southern Patagonian Ice Field in Chile may reach the ocean in fjords, with steep fronts and sharp cre-

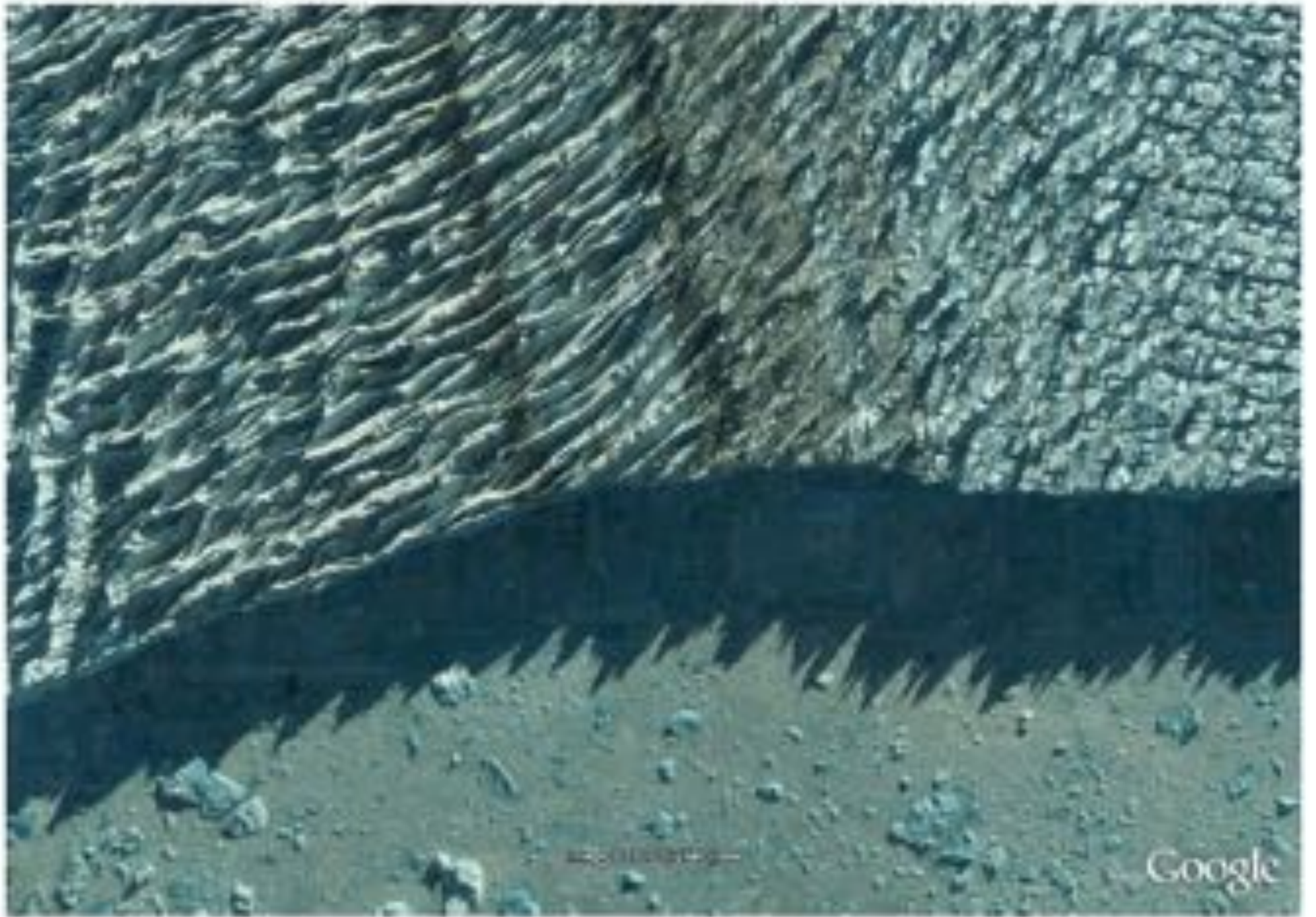
vasses and calving icebergs. Scenes are several 100 m wide (Image credit: ©Google earth 2012).

b



Google

c



© 2008 Google

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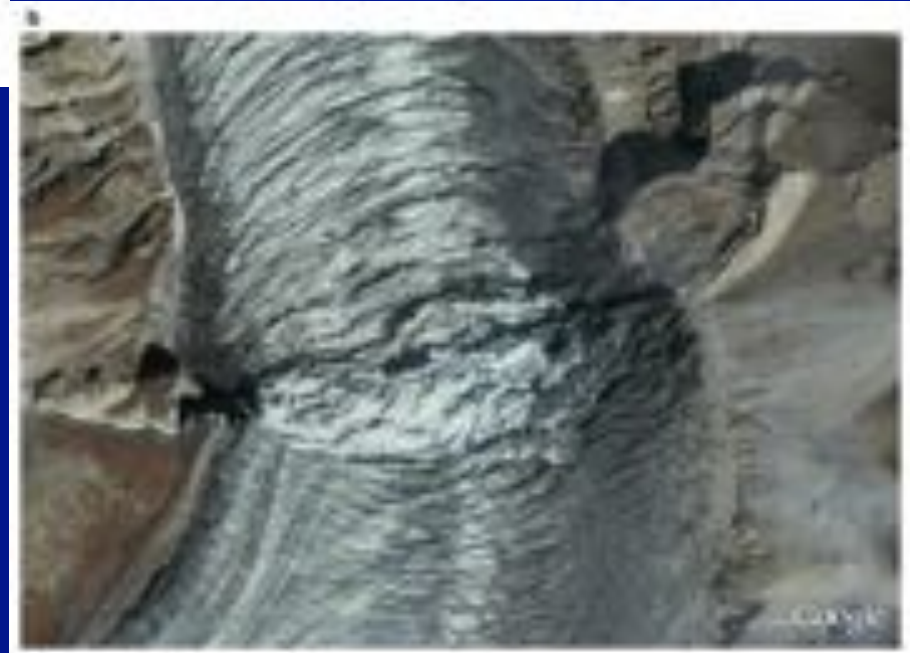
Fig. 1.1.1 (a) The grey area in the background is the ocean. The white plastic waste is the result of the plastic waste management system. (b) The white plastic waste is the result of the plastic waste management system. (c) The white plastic waste is the result of the plastic waste management system.

(a) The grey area in the background is the ocean. The white plastic waste is the result of the plastic waste management system. (b) The white plastic waste is the result of the plastic waste management system. (c) The white plastic waste is the result of the plastic waste management system.



Fig. 13.22 An alluvial plain braided river system with bars. This braided river has channels of irregular planimetric form by a wide degree of shifting according to time with it. It is typical of the majority of braided rivers in a young valley plain. (Map of the Tropic of the Nile, Nile Basin, 1971)

Figure 13.23 shows a braided river system with bars. This braided river has channels of irregular planimetric form by a wide degree of shifting according to time with it. It is typical of the majority of braided rivers in a young valley plain. (Map of the Tropic of the Nile, Nile Basin, 1971)



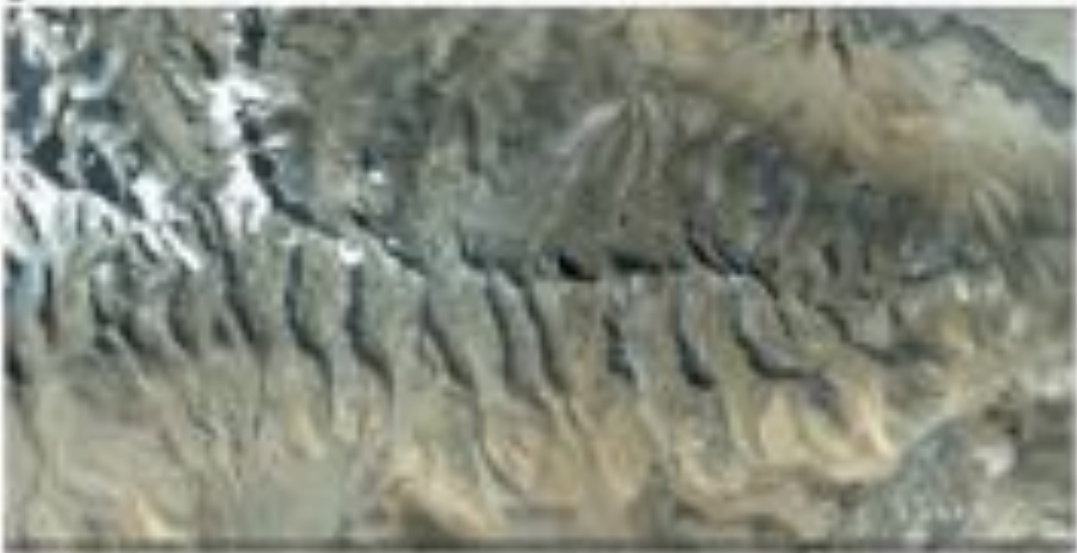


Fig. 10.14B (a) View from southeast of the mountain range with only the upper part of a glacier system (i.e., ground-feeding glacier) visible in a 1000 ft and 1000 ft with a width of 10 km. The lower part of the mountain range, now free of ice, but with typical 10 degree slopes and a network of streams starting into the base north of the mountain range, are visible in the lower part of the image (red 'X').



Fig. 12.15 A large boulder has propped the glacial ice beneath from sublimation and melting and formed a "glacial table" in the European Alps (Image credit: D. Kuffner)

8

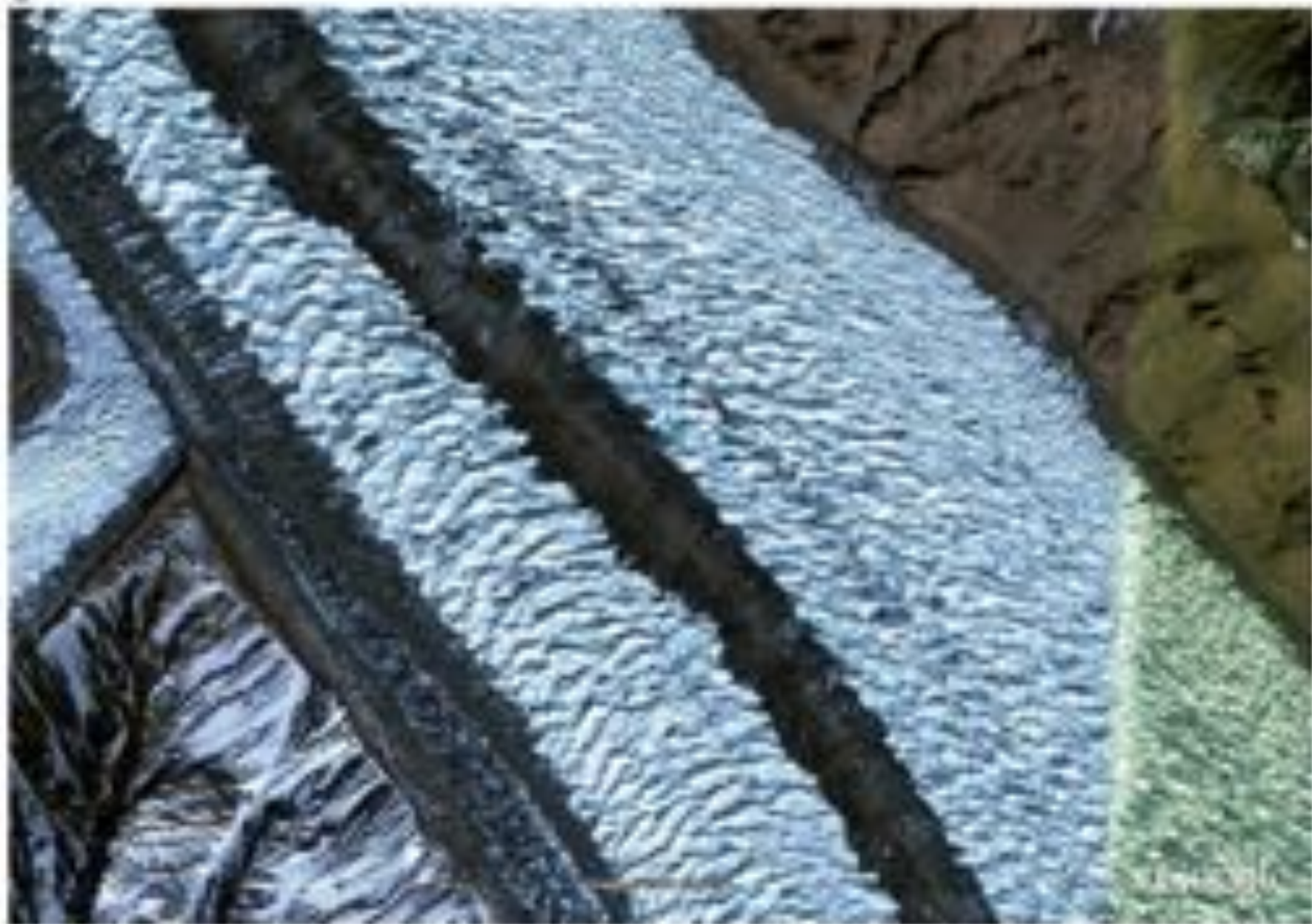


Fig. 11.56 Glaciers with medial moraine bands, documenting the confluence of a few or even many separated ice streams. (a) Triangle from the Himalayas, and (b) from eastern Greenland (Image credit: US Army, 2002)



17

3



Fig. 12.17 (a, b) Two examples of Himalayan glaciers with a thick cover of surface moraines promoting the glacier ice. As a result, the glaciers end with thick tongues, which may also point to a period of glacier advances. (Image credit: ©Google earth 2011)

b



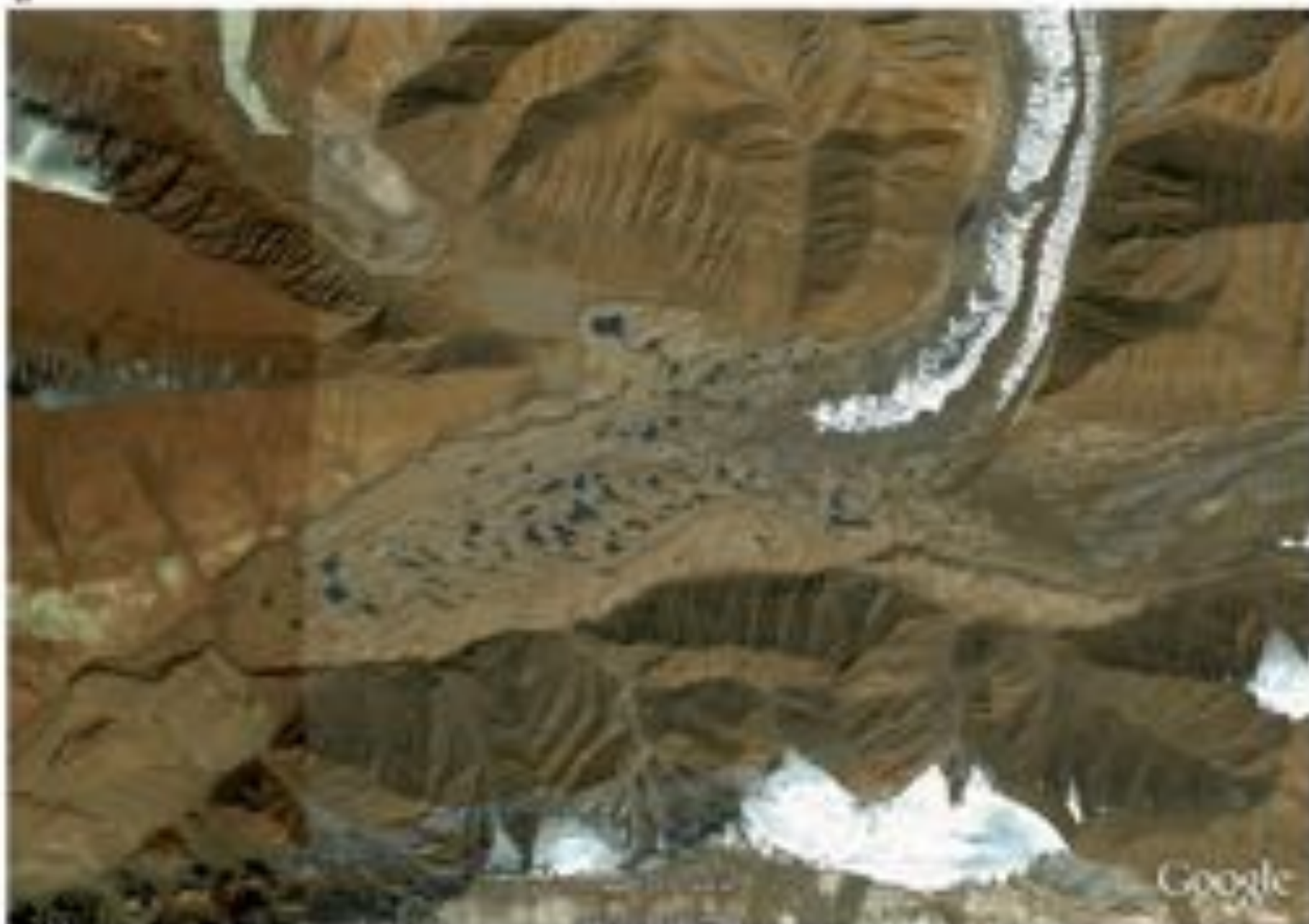


Fig. 12.18 (a, b) Southern Asian glaciers in the Himalayas, where the ice is almost entirely hidden under thick snow and material, but outflows like depressions show that it still exists below the till (Image credit: ©Google earth 2012)



Fig. 12.19 (a) Large cirques in the southern Canadian Rocky Mountains (Image credit: D. Kallitani). (b) A group of cirques in north-west Iceland. The dark patches are lakes and document that the cirques

were deepened by glacial erosion, now separated from the slopes of the valley by sills (Image credit: CC Image north 2012).

b







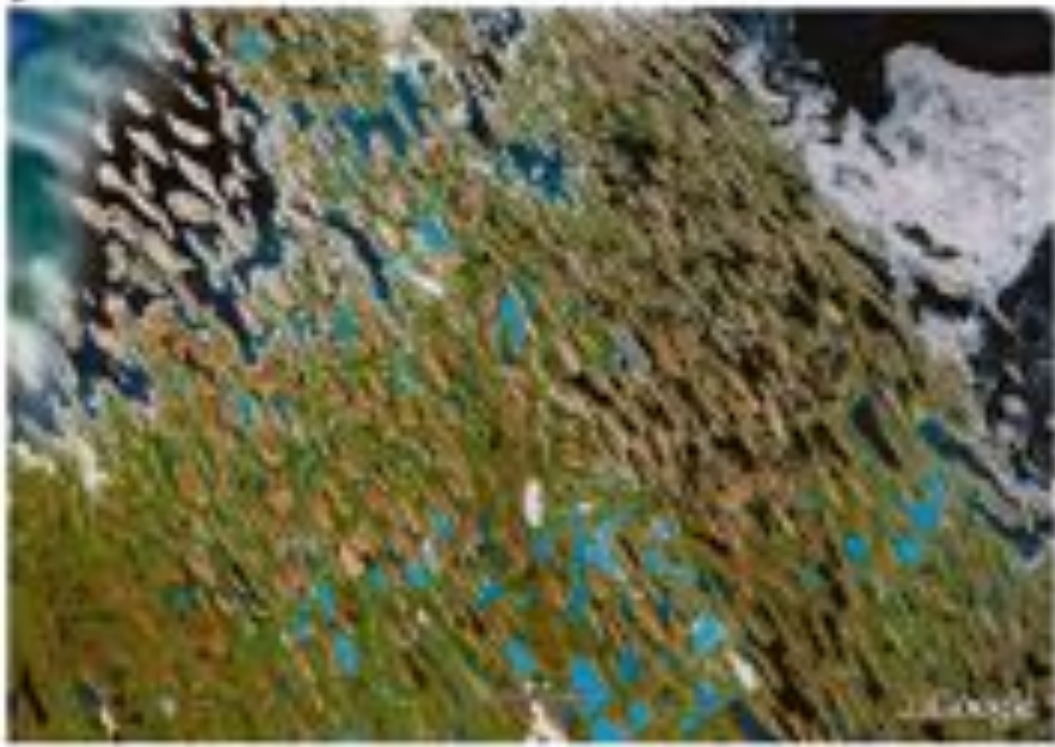






Fig. 10.20 (a) shows a river channel with a prominent meandering pattern. (b) shows a close-up view of a river channel with a highly sinuous, meandering path. (c) shows a close-up view of a river channel with a highly sinuous, meandering path. (d) shows a close-up view of a river channel with a highly sinuous, meandering path.

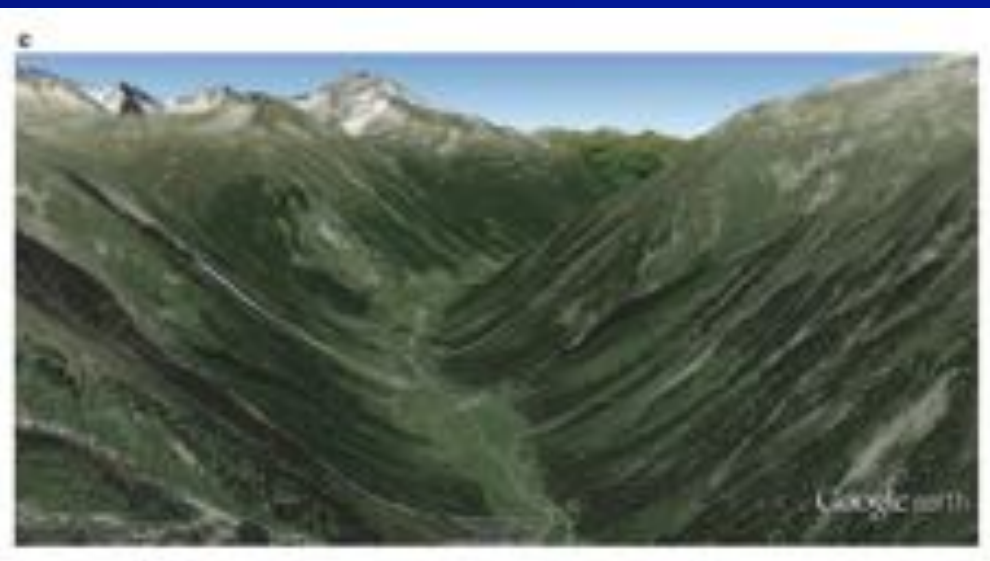




Fig. 12.25 The "Finger Lakes" (up to 70 km long) are places of former glacier tongues during glacial periods that carved out these depressions into a flat landscape east of the Great Lakes of USA and Canada. The

site is at about 42°41'N and 76°40'W. The glacial ice came from the north (Image credit: ©Google-earth 2012)



Fig. 12.26 (a) Chaotic ground moraine particles (fill) from a valley bottom in southern Switzerland. Most of the deposit has been washed away, but under large boulders columns or needles of the sediment may be preserved. They are called "needle pyramids" in the European Alps, although they usually have the form of columns (Image credit:

D. Kellou). (b) Deformation of meltwater deposits by an advancing glacier east of Bariloche in western Argentina about 13,000 years ago at the end of the last glaciation. (c) Detail of (b) showing the small faults in the silt strata documenting that the sediment was frozen during the last movement (Image credit: D. Kellou)

b



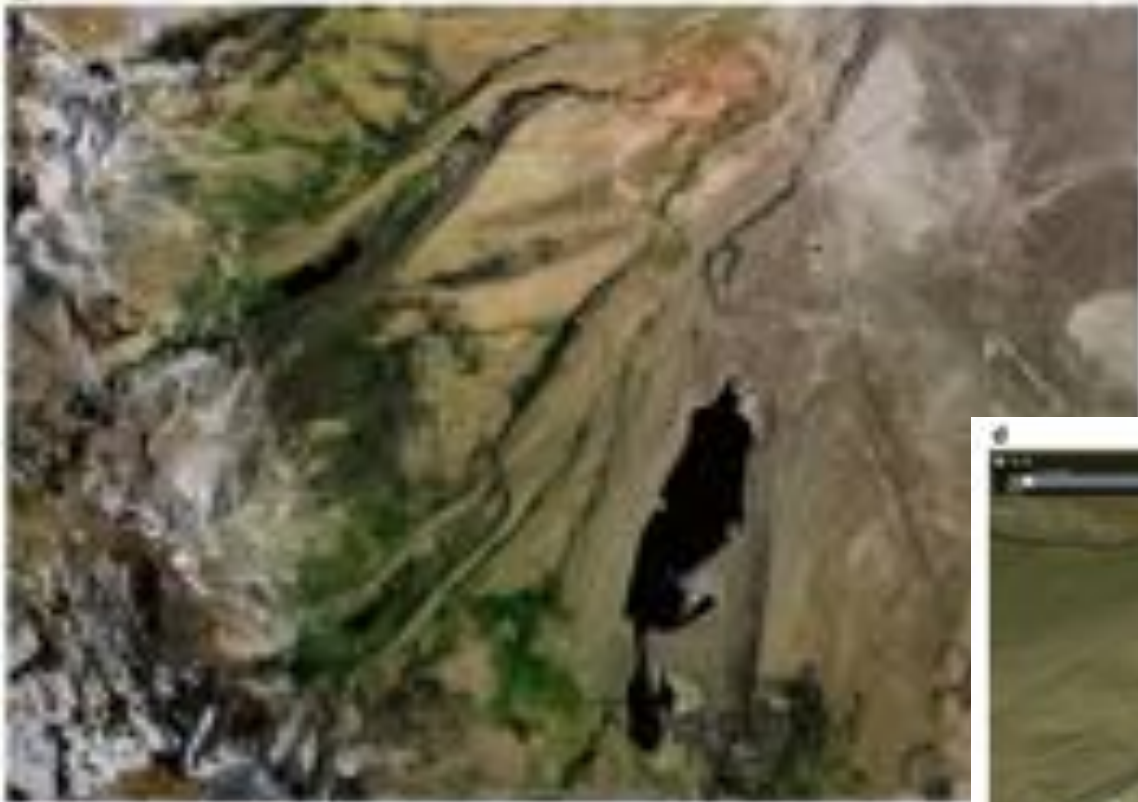
c





Fig. 12.27 (a) Lakes, as well as lateral and terminal moraines, in front of glaciers in southeastern Tibet document a young glacier retreat at $28^{\circ}15'N$ and $86^{\circ}17'E$. Scene is about 35 km wide. (b) Well preserved lateral and terminal moraines near $37^{\circ}30'N$ and $119^{\circ}05'W$ along the east side of California's Sierra Nevada recording the maximum extent of glaciers during the last glacial maximum advance and some late glacial

retreats. Scene is 20 km wide. (c, d) Terminal and lateral moraines from receding glaciers in the Himalayas at about $27^{\circ}35'N$ and $87^{\circ}47'E$ in (c), and $28^{\circ}27'N$ and $86^{\circ}27'E$ in (d). Lakes developed behind the wall of the terminal moraine by meltwater. (Image credit: ©Google earth 2017)



冰缘地貌



Fig. 13.1. Distribution of permafrost types in the Arctic and sub-Arctic environments (adapted from Murray, 1988). (continued)

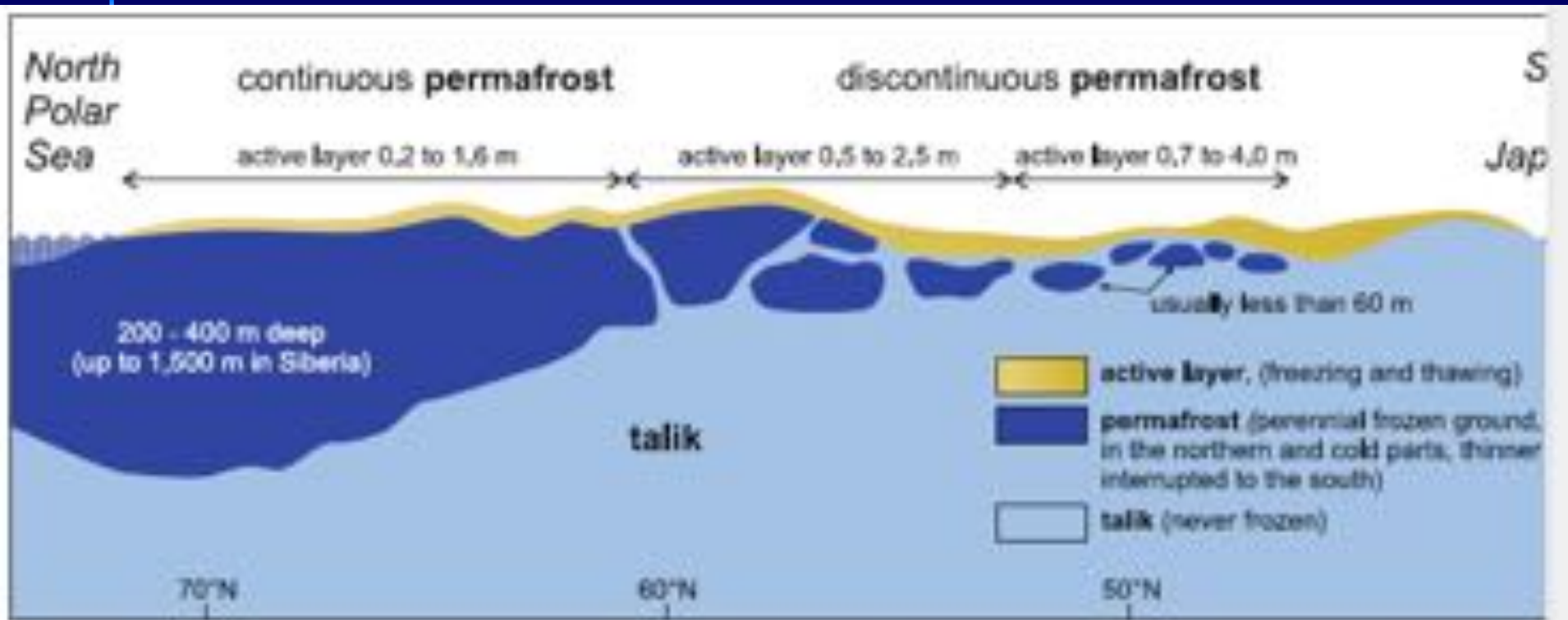


Fig. 13.2 A north-south section across the permafrost landscape in eastern Siberia (Russia). In the north, permafrost is several hundred meters deep and continuous. Towards lower latitudes, it becomes thinner and shows gaps, whereas at even warmer latitudes it is separated

into isolated patches and is only a few meters deep. As climate c affects permafrost from the surface, the thawing processes may ac ate permafrost decay in all latitudes (Image credit: A. Hager)



3



4





Fig. 14.8 Three distinct layers from the top to the bottom clearly developed in the steeping process of soil during a leaching process in soil profile during the process deep to shallow of the leaching process of atmosphere for long years. This type of soil is called *leached soil* (Image credit: G. G. G. G.)



Fig. 14.9 Aerial view of a landscape showing a network of small drainage channels (rills) and small streams (ditches) in a hilly area. The channels and streams are formed by the process of runoff water at the top of the slope.



Fig. 16.6. Frequent damage with perforations and lesions on fern fronds. Damage at 10:15 AM and 10:30 AM on a 40-year-old fern frond. Damage is a result of insect feeding and damage to a fern frond. The fern frond is a result of insect feeding and damage to a fern frond. The fern frond is a result of insect feeding and damage to a fern frond.



Fig. 16.7. A dark, irregularly shaped object, possibly a piece of wood or a rock, partially submerged in water. The object is surrounded by splashing water and ripples, suggesting it has just been dropped or is being moved.



Fig. 13.8 (a) Highly textured salt flat in the Australian Alps at 1,000 m above sea level, formed by the splitting and rock salt crystals during the recession of glacial streams and the expansion of water.

These massive natural "dishes" or basins may have formed in a recent period. (b) Another salt flat in central Australia. These dishes form up to 1 m in height and 100 m in diameter, average width in Australia.

b





Fig. 18.11 (a) Cross-section of a stem of a dicotyledonous plant showing a vascular bundle. The vascular bundle is composed of xylem on the left and phloem on the right. The vascular cambium is located between the xylem and phloem. The pith cell is large and contains several small, dark, oval-shaped structures. (b) Cross-section of a stem of a dicotyledonous plant showing a vascular bundle. The vascular bundle is composed of xylem on the left and phloem on the right. The vascular cambium is located between the xylem and phloem. The pith cell is large and contains several small, dark, oval-shaped structures.

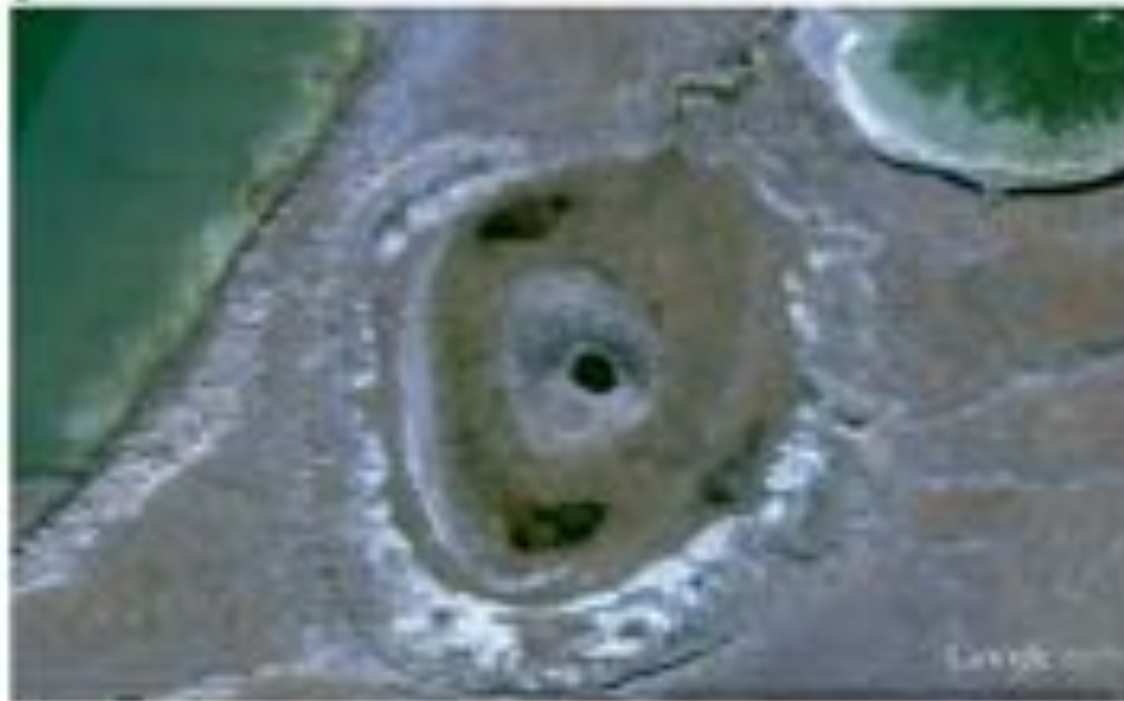




Fig. 13.15 With low temperatures (-25 to -40 °C) in winter, the frozen ground shrinks repeatedly and cracks open up in networks, which will be filled by meltwater in the warmer times of the year. The water travels deeper and opens the cracks farther in each thawing/freezing

cycle. The cracks show more or less pure ice in the form of ice wedges and this kind of patterned ground is called "ice wedge polygons". The site is located in northern Alaska at $70^{\circ}50'N$ and $155^{\circ}30'W$ and the scene is about 5 km wide (Image credit: ©Google earth 2012)



Fig. 13.14 Irregular network of patterned ground by ice wedge polygons in a shallow depression of northern Russia at $71^{\circ}55'N$ and $152^{\circ}52'E$. Scene is 2.3 km wide (Image credit: ©Google earth 2012)

B

Fig. 13.17 (a) Ice wedge polygons in the permafrost of northern Alaska. Scene is 1 km wide at $70^{\circ}55'27.57''N$ and $155^{\circ}19'35.19''W$. The overall pattern evidently is adapted by the sediment character and/or slight topography from the nearby river. Single polygons have diameters up to 40 m. (b) A 1.5 km wide scene at $70^{\circ}22'22.48''N$ and $151^{\circ}01'41.51''W$. The pattern is irregular with a diameter of polygons of 15–35 m. We can identify dark lines within the elevated rims of the polygons which are melting ice wedges, whereas the elevation is the

result of the pressure by actively freezing vertical fillings of fissures. As along each fissure a double low rim is formed, the polygons form a network of low-centered features that are filled by water in summer and frozen over winter. Freezing of the ponds also will exert pressure towards their outer rims and elevate the network lines, which may be under the influence of pressure from both sides (Image credit: ©Google earth 2012)

b



b

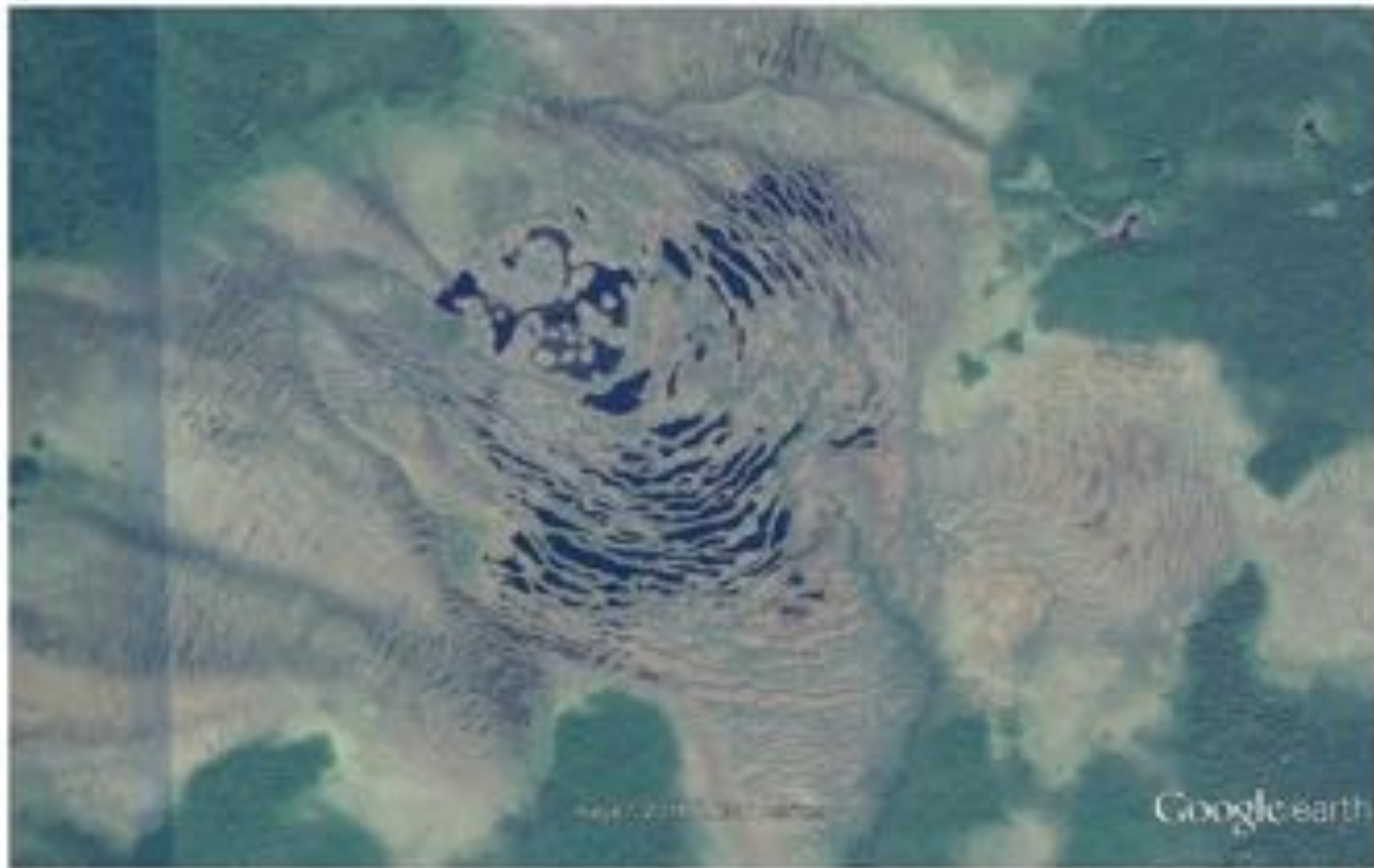




Fig. 13.20 Two examples of recent thermokarst, which means thawing of permafrost. (a) Patches of the former permanently frozen ground are now collapsed by thawing, and new lakes with irregular but steep contours (ice and debris cliffs) occur. Scene is 4 km wide, at 66°45'N,

101°17'E (b) Destruction of an older depression. Scene is 5.2 km wide at 66°38'N, 101°27'E. Both examples are from northern Siberia (Image credit: ©Google earth 2012)

b



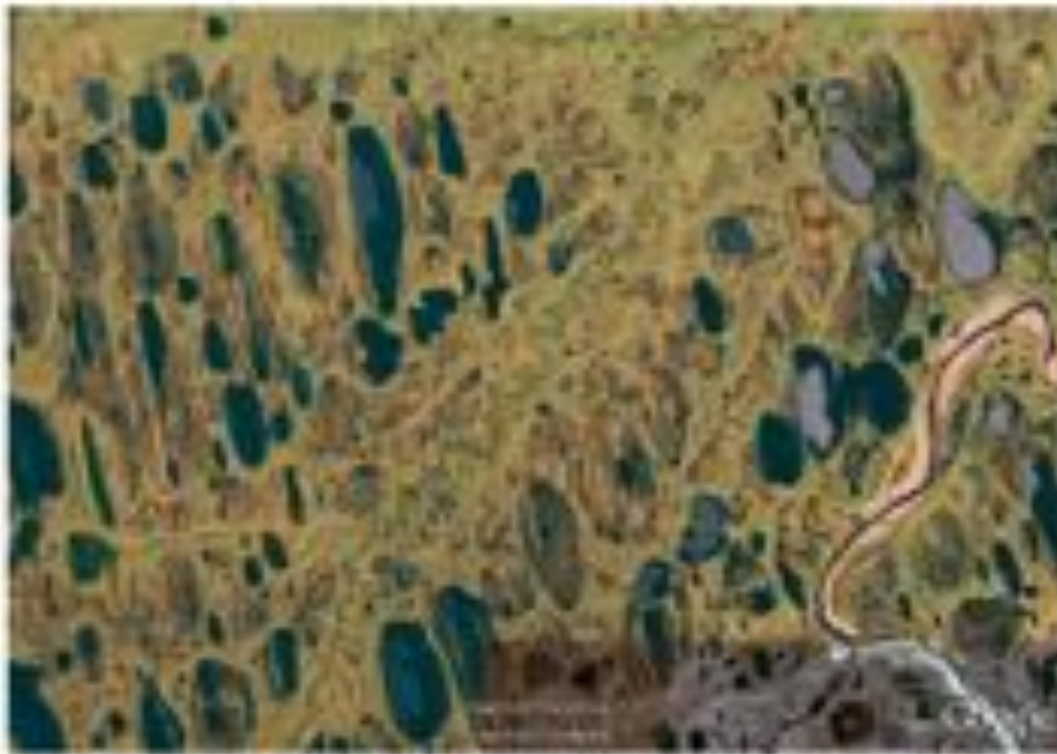


Fig. 13.41 Shrinkage cracks in a polymer matrix, formed by excessive bond contraction during the cooling process. Also, large particles have to stretch, causing cracks to form. (Source: *Plastics and Composites* (Chicago: ASM, 1974), p. 217.)



Fig. 13.42 "Crack-up" (shrinkage cracks) in the lower half of a polymer matrix. (Source: *Plastics and Composites* (Chicago: ASM, 1974), p. 217.)

人工地貌





Fig. 16.3 In the northwestern parts of China, the bare landscape is transformed into terraces for crops and vegetables (38°12'N, 111°47'W) (Image credit: ©Google earth 2012)



Fig. 14.3 Sand mining for construction purposes in southern Jordan at 31°01'N and 36°05'E. Image shows a 4.2 km wide section of the desert landscape (Image credit: ©Google earth 2012)



Fig. 14.6 (a) An open pit mining for Tertiary lignite in western Germany. The width of the pit is nearly 4 km with a depth of 130 m. The mine is at 50°32'N and 6°20'E. Partial refilling of the mine (the green terraces in the south) is now the action taken to minimize the environ-

mental impact for the landscape. (b) Another lignite open pit mine in western Germany at 51°05'N and 6°57'E. The mine is 20 km wide. The partially refilled pit is 8 km wide and the hills of residual material is about 80 m high and about 1 km in diameter (Image credit: ©Google earth 2002).



Fig. 14.14 View of the rock face at the base of the cliff at the base of the cliff, showing greater than 40 feet of open bedding up to 100 ft deep. The bedding here may be the result of gas flow (Image credit: Bill Bergman/ISTOCK)



Fig. 14.11 Crater of the Demon, showing its rim and the interior of the crater. The crater is composed of (a) and (b) and is a true crater. The gas is coming out of the crater (image courtesy of the USGS).



Fig. 14.14 Modification of river runoff and sediment transport by reservoirs (dams indicated by arrows) around $47^{\circ}05'N$ and $119^{\circ}37'W$ along the Columbia River and the surrounding areas, USA (Image credit: ©Google earth 2012)



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