

# Facing the cliffs: elite rock climbers discuss the geology of their favorite climbing sites

**S** *Science World*, January 2, 2012

1 Kate Rutherford clings to the steep rock face beside Yosemite Falls in California's Yosemite National Park. She has jammed her hand into a crack in the rock as she looks for the next hold on her route up the cliff. Her toes are perched on small ridges in the rock no wider than a pencil. Grip by careful grip, Rutherford makes her way up the cliff. Along the way, she clips her rope to metal hooks called carabiners and removable supports called cams. Sometimes, when she can't find a crack for cams, she uses bolts that previous climbers drilled into the route. The rope will prevent her from falling all the way down.

2 Professional rock climbers like Rutherford travel the world performing gravity-defying climbs. As they tackle new routes, they get to know the rocks. "You really get up close and personal with all different kinds of rock. There's so much geology going on in our lives as climbers," says Rutherford. Each climb is a new adventure, no matter if you're an expert climber or a novice. Across the United States, mountainsides, cliffs, and boulders created by a variety of geological forces provide unique challenges for climbers.

[ILLUSTRATION OMITTED]

## SHEER FACES

3 "Granite, and all of the rocks in the granitic family, are definitely the most sought-after types of stone to climb," says Sarah Garlick, a geologist and rock climber who wrote a guide to the geology of world-famous rock-climbing sites. Yosenfite, located in the Sierra Nevada mountain range, is among climbers' top destinations (see Climbing Records, right). Its granite is an igneous rock that was originally formed when magma deep within a volcano slowly cooled 100 million years ago (see The Rock Cycle, p. 7).

4 Over the years, the Sierra Nevada mountain range rose, and weathering due to wind, rain, snow, and ice wore down the softer surrounding rocks. Erosion carried the rock particles down rivers. "During the last ice age, 10,000 years ago, glaciers swept through the area, carving the steep rock faces of El Capitan, Half Dome, and the other famous rock faces within Yosemite," says Garlick.

## LAYERED ROCKS

5 While Yosemite's granite is perfectly suited for epic cliff-face climbs, the sandstone across Utah offers climbers its own unique challenges. Sandstone is a type of sedimentary rock that forms when particles from other rocks are compressed and cemented together over millions of years. In Utah, the rocks show many layers of sandstone that tell the history of the area. For example, 200 million years ago, the Wingate sandstone that makes up the cliffs of Indian Creek near Moab, Utah, was originally a desert covered with dunes, much like the Sahara Desert. Just beneath that sandstone is what's called the Chinle Formation, which is mainly made up of river-bottom sediments. From studying the area's layers, geologists can tell that Utah has undergone vast changes throughout time.

[ILLUSTRATION OMITTED]

6 Some sandstones don't make the best climbing surfaces because they can be fragile and break apart easily. However, Indian Creek is an exception. The Wingate sandstone is smooth and hard. It also has many cracks running vertically up the steep rock face. These cracks, called joints, were created when the Rocky Mountains were uplifted. Pressure caused the rock above to bend, or fold, and eventually cracks like the ridges in a bendy drinking straw formed.

7 These cracks can be slim--allowing only finger grabs--or gaping chasms that you can fit an arm or leg into. Climbers follow a seam up the cliff face using a technique called jamming. "It's a really unique style, where you're climbing strictly in the spaces in between the rocks," says professional climber Cedar Wright. "There's really only one Indian Creek, so people come from all over the world to experience that style of climbing."

[ILLUSTRATION OMITTED]

### SLANTED FORMATIONS

8 Just outside New Paltz, New York, is another climbing attraction, called the Shawangunk Ridge, or the Gunks for short. The ridge has horizontal cracks, rather than the vertical cracks of Indian Creek. Initially, the rock here was sedimentary: a river-lain conglomerate. But over time, the sedimentary rock was squeezed, heated, and transformed into a metamorphic rock called quartzite. Not only did the squeezing compress it into a new type of rock, but it also caused the area to buckle. "The layers have been tilted backward, so it has a nice angle for climbers," says Garlick. "And the rock is smooth and hard, rather than crumbly sandstone." The Gunks also draw climbers who specialize in a technique called bouldering. Giant boulders that are 3 to 6 meters (10 to 20 feet) tall dot a nearby valley. Since the heights aren't as extreme as the ones climbers face when they scale rock walls, ropes and harnesses are unnecessary when climbing boulders. Garlick is intrigued by the Gunks' boulders, "because, as a big cliff goes through the weathering and erosion process, it produces [the] boulders that we climb," she says. "Then those eventually will erode away into particles that may become a future sandstone."

9 No matter where you are in the U.S. or around the world, you can probably find rocks relatively nearby that climbers have scaled. "It's a good sport, and we learn a lot about geology through our love for the rocks," says Wright. "Rocks really punctuate the landscape. They're beautiful, and for some people they beg to be climbed."

### THE ROCK CYCLE

[ILLUSTRATION OMITTED]

10 This cycle has no starting point. It has been going on for millions of years. Rocks form deep underground and get pushed to the surface as Earth's crust moves or volcanoes erupt. There, wind and water wear away at the rocks.

11 **IGNEOUS ROCK:** Formed when metamorphic rocks melt to form magma (melted rock), which then cools

11 underground or erupts and cools on Earth's surface.

12 METAMORPHIC: Formed when heat and pressure change sedimentary, igneous, or other metamorphic rocks.

13 SEDIMENTARY ROCK: Formed when layers of sediment are squeezed and cemented together.

#### ROCK CLIMBING IN THE U.S.

14 Here are the three rock-climbing sites mentioned in the article. In which state would you find the famous rock-climbing site made of sedimentary rock?

[ILLUSTRATION OMITTED]

#### CLIMBING RECORDS

15 Yosemite's El Capitan is one of the most famous formations climbers visit. This vertical granite rock face is shaped like the prow of a boat. Its tip rises 890 meters (2,920 feet) from the base to its summit. The first climbing route established on El Capitan, called "the Nose," goes up the front edge. In 1958, a team led by rock-climbing legend Warren Harding took 18 months to drill bolts and hammer big nails called pitons into the rock to which they attached ropes. All told, it took them 47 days of actual climbing to make it to the top of the Nose.

16 Nowadays, experienced climbers take several days to make the ascent, relying on tents called portaledge that hang from the wall. But the route has been scaled even faster: In late 2010, daredevil free solo climbers Dean Potter and Sean Leary scaled the Nose in two hours, 36 minutes, and 45 seconds. They accomplished such a speedy ascent by leaving most of their heavy climbing gear behind.

### Questions

1. In paragraph 3, how did the granite from Yosemite form?

2. In paragraph 4, what carved the rock faces of Yosemite?

3. In paragraph 5, what does the Wingate Sandstone show about Utah's past environment?

4. In paragraph 6, how did the cracks at Indian creek form?

5. Would you ever climb El Capitan? Why or why not?