Lithomorphogenesis of karst surface – Karren

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Karren develop uniquely, yet characteristically on diverse rocks and in diverse environments. The knowledge of the network of karren throughout the world, which clearly reveals the evolution of the surface of integral, three-dimensional karst landscapes, has been significantly enhanced also by the findings from the presented examples. A variety of factors influencing different rocks shape rock features which are, when connected into a rock relief, an important trace of the manner of karren formation and of their evolution. The different shapes enable us to discern the diverse periods of evolution and the evolution during each period. In both cases, the rock relief transitions from one shape into another. Good knowledge of the rock relief is the basis for understanding the evolution of the karst surface. The rock allows for the creation of certain features and dictates special shapes.

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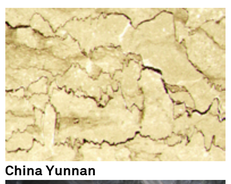
Brazil Minas Gerais


Brazil Minas Gerais


Brazil Minas Gerais


China Yunnan


China Yunnan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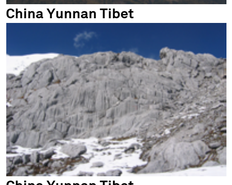
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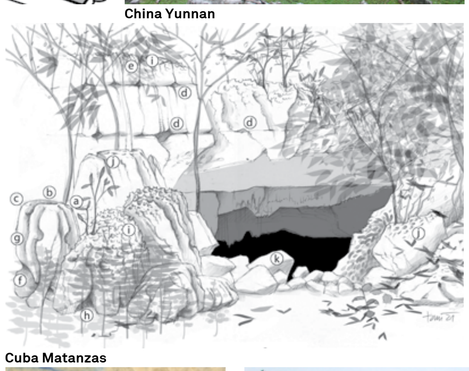
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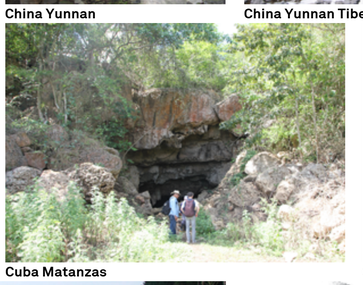
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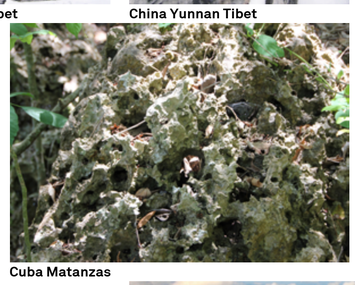
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Iran


United Arab Emirates


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United Arab Emirates


Italy Sicily


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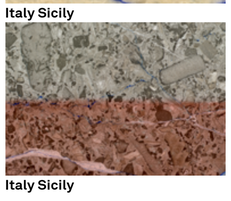
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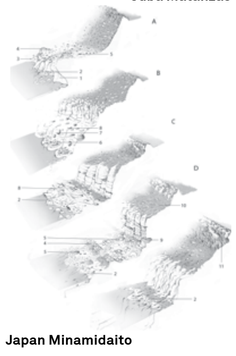
Slovenia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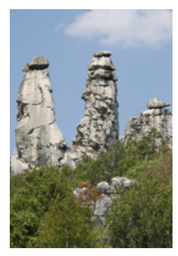
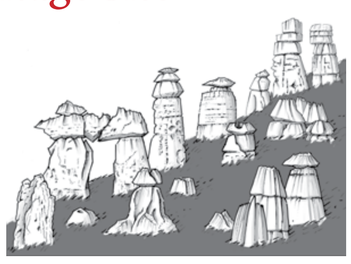
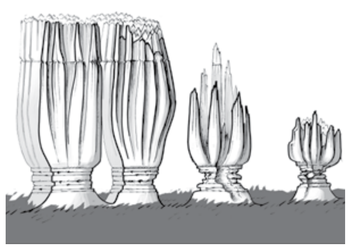
Shilin Stone Forests (Yunnan, China), a UNESCO World Heritage Site







Stone forests are a unique karst surface landform and a unique form of pinnacle karst. The area of Shilin stone forests is composed of Lower Permian carbonates of the Qixia and Maokou formations. Characteristics of the Qixia formation are micrite limestone with intercalations of dolomite and dolomitic limestone with intermediate sheets of schist. In the Maokou formation, limestone alternates with dolomite and dolomitic limestone. Carbonate, which was already undergoing the process of karstification, was covered by Permian basalt and tuff that influenced its shaping and in places metamorphosed the rock. More or less horizontal layers of the rock of various thickness and composition are crisscrossed by vertical fissures or cracks. Each of these features can have an important influence on formation of the network of stone pillars in a forest, on their size and shape, and consequently on the rock relief. They interact in various combinations, fostering a vast diversity of stone forests. The Shilin stone forests were formed predominantly through dissolving of rock below soil and sediments. A unique development of stone forests is reflected in their rock relief. Exposed subsoil karren is reshaped by rainwater. Rainwater sharpens tops of pillars and transforms traces of their original subsoil formation. Subsoil and composed rock forms, especially the largest ones, are the most distinctive. Subsoil rock forms include scallops, large channels, notches, and half-bells and subsoil channels and cups on broader tops, while composed rock forms include channels leading from subsoil channels or solution cups, which dissect walls of pillars. The lengthy development of stone forests has allowed creation of large karst forms. Due to the development of caves beneath the forests and the erosion of alluvium and soil that previously covered the carbonate rock, exposure takes place faster than dissolving of the rock by rainwater.

Lithomorphogenesis and Rock Relief of Tropical Karren in Cuba (Mogote in Viñales)

In the area of the Viñales Valley we chose the Felo Pérez mogote for conducting thorough research of karren. The Felo Pérez mogote is made up of rocks belonging to the Guasasa Formation. The mogote rock is highly monotonous throughout the examined geological profile. Micritic limestone with nearly 98% on average of calcium carbonate is predominant, most of which is heavily tectonically crushed. The rock in the entrance section of the Cueva Afán is of the Güines Formation. In the geological profile, the examined rock is homogeneous dolosparite, porous dolopelmicrite and dolobiointrasparite with an average dolomite content of 72%. The top parts of the two examples of karren, either entirely denuded of soil or partly covered by soil or weathered debris, are shaped by rain and the vertical percolation or trickling of water, while the bottom parts are mostly shaped by the flow of water at the contact with the soil and alluvium. Under the dense growth of trees and shrubs, on the rock denuded of soil and subsoil shaped, weathered debris accumulates and creates cups underneath; in their mature form, these cups leave a decisive mark on the rock relief and are the typical form of karren under such conditions. They can be found in other environments too, but they are most distinct under tropical vegetation.

Karst Karren on Marbles with Characteristic Rock Relief and Scaly Splitting of the Rock, Altai Republic (Russian Federation)

Investigated rocks belong to regionally metamorphosed carbonate rock into coarse-grained marbles. Marbles were strongly affected by fracturing on the macro and micro levels, and they always have pronounced foliation. In the Ak-Kaya valley the manner of splitting is dictated by the vertical thin layered composition of the recrystallized rock. The scales are several centimeters thick, usually dissect the wall in a step-like manner, and accumulate beneath it. The water flows along cleavage surfaces in the rock and perforates it with smaller tubes that are denuded in the process of disintegration. The disintegration is dictated by the fine perforation of the thin layered rock and apparently by the freezing of water in the cavities. A characteristic example of scaly splitting of thickly layered rock is revealed in the sunny walls of Ak-Bom. The scales vary in size from square centimeters to several square meters and are relatively thin. In places where scales fall off, steps occur. Parts of the rock that protrude from the walls split the most distinctly, and therefore the walls are evenly rounded. At the confluence of the Katun and Chuya rivers, the rock splits along cleavage surfaces where the lower parts of the slope of the valley formed. The layers are a few decimeters thick. Interlayer cavities form into which water brings sediment and flowstone is deposited on the ceiling above it. Due to the increasing volume and the freezing of moist sediment in them, the upper layer swells and bursts and its pieces slide down the slope. Scaly splitting of the rock imprints the most distinct stamp on the rock relief. Over time, the traces of rock formation described above can alternate between the dominant chemical dissolving and scaly splitting or mechanical disintegration. The variety of scaly splitting is mostly determined by the properties of the layered or grained metamorphosed carbonate rock. This was also established by Ollier (1984, 15, 18), where he gives examples of scaly splitting as a consequence of the impact of temperature change on intergranular and fissured porous and moist rock and the freezing of moisture. Due to the metamorphosing, the carbonate rock has the same properties in this case. All three cases are unique. The inclination of the most distinct splitting layers also has an important influence on the shape of the karren.