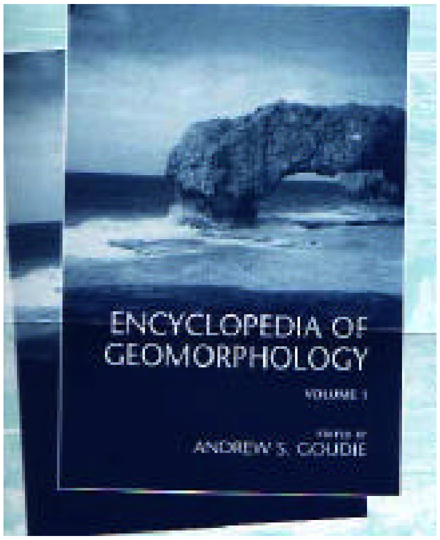

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ROCK COATING

About 15 per cent of the Earth's landscape consists of bare rock surfaces. Yet the common phrase 'bare rock' is truly a misnomer, because paper-thin accretions coat almost all of these rock surfaces in all terrestrial environments. Studies on the physical and chemical characteristics, origin, geography and utility of these deposits has spawned over 3,000 scientific papers. Plate 100 illustrates a few examples.

Alexander von Humboldt (1812) initiated the scholarly study of rock coatings by studying the composition, origin, spatial distribution and environmental relations of coatings such as those found along tropical rivers. In the past two centuries, researchers have documented hundreds of different types of rock coatings found within the fourteen major categories listed in Table 39.

The three most common rock coatings are rock varnish (see DESERT VARNISH), silica glaze and iron films. Silica glazes occur in warm deserts, cold

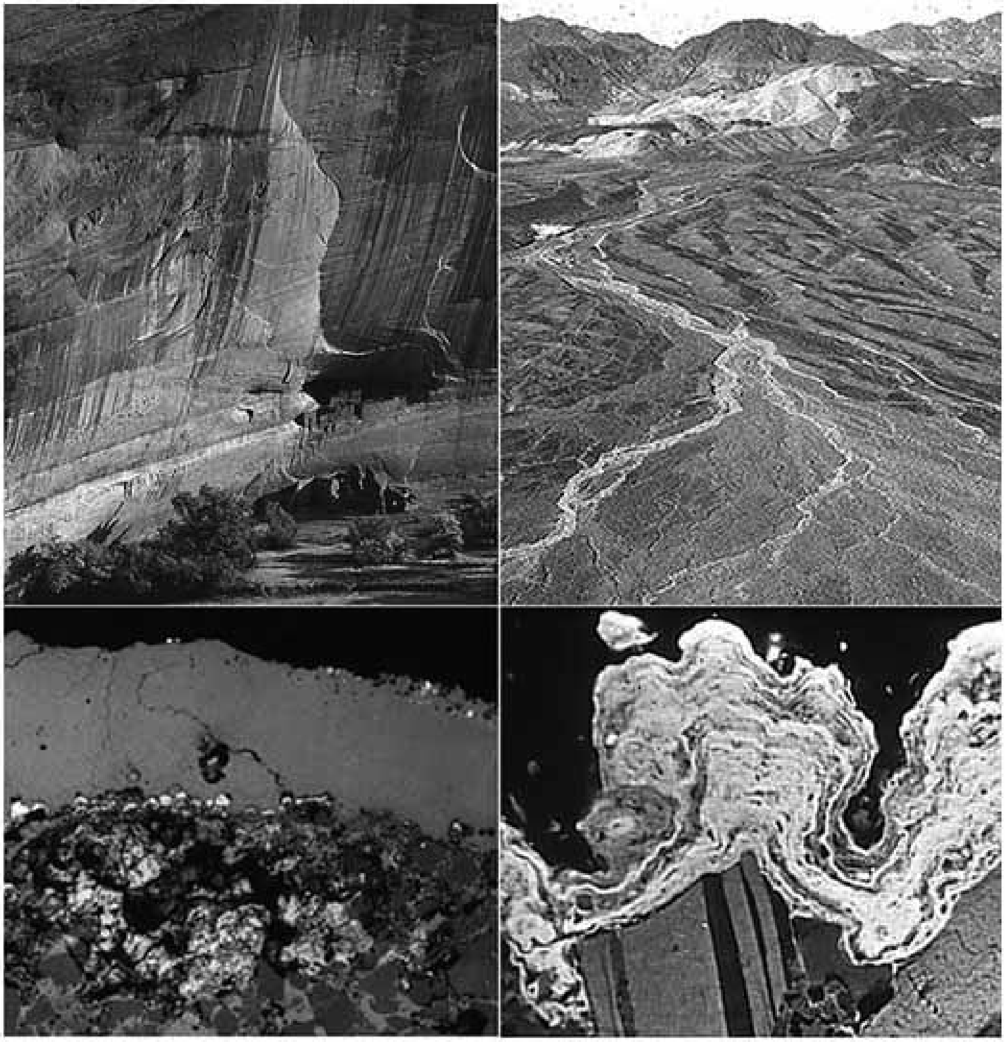

Plate 100 Upper left: a vertical face at Canyon De Chelly, USA, is streaked with heavy metal skins, iron films, lithobiotic coatings, oxalate crusts, rock varnish and silica glaze. Upper right: alluvial fan in Death Valley deposits the same light-coloured rock types in active streams. But over time, rocks in abandoned stream courses are darkened by desert varnish. Lower row: the electron microscope images (backscatter detector) illustrate that rock coatings are external accretions, exemplified by an oxalate crust in the lower left image that is about 0.5 mm thick and desert varnish on the lower right that is about 0.1 mm thick

deserts like Antarctica, on dry tropical islands, along tropical rivers, mid-latitude humid temperate settings, and various archaeological settings. Silica glazes probably precipitate from soluble Al-Si complexes $[Al(OSi(OH)_3)^{2+}]$ that are released from the weathering of clay minerals. Rust-coloured iron films display a wide variety of characteristics in very different climates and microenvironments. For example, rocks in the Dry Valleys of Antarctica host iron hydroxides that both form a micron-scale accretion and a weathering rind (see RIND, WEATHERING) over a millimetre thick. In a very different setting, iron oxyhydroxides impregnate rocks in arctic streams (Dixon *et al.* 2002).

Geomorphologists have long used intuition to interpret rock coatings and their relationship to the geomorphic setting. For example, some have believed that PEDIMENTS are fossil landforms, in part because the presence of rock coatings must

Table 39 Major categories of rock coatings

General type	Description	Related terms
Carbonate skin	Coating composed primarily of carbonate, usually calcium carbonate, but could be combined with magnesium or other cations	Caliche, calcrete, patina, travertine, carbonate skin, dolocrete, dolomite
Case hardening agents	Addition of cementing agent to rock matrix material; the agent may be manganese, sulphate, carbonate, silica, iron, oxalate, organisms or anthropogenic	Sometimes called a particular type of rock coating
Dust film	Light powder of clay- and silt-sized particles attached to rough surfaces and in rock fractures	Gesetz der Wüstenbildung; clay skins; clay films; soiling
Heavy metal skins	Coatings of iron, manganese, copper, zinc, nickel, mercury, lead and other heavy metals on rocks in natural and human-altered settings	Described by chemical composition of the film
Iron film	Composed primarily of iron oxides or oxyhydroxides; unlike orange rock varnish because it does not have clay as a major constituent	Ground patina, ferric oxide coating, red staining, ferric hydroxides, iron staining, iron-rich rock varnish, red-brown coating
Lithobiontic coatings	Organic remains form the rock coating, e.g. lichens, moss, fungi, cyanobacteria, algae	Organic mat, biofilms,
Nitrate crust	Potassium and calcium nitrate coatings on rocks, often in caves and rock shelters in limestone areas	Saltpetre; nitre; icing
Oxalate crust	Mostly calcium oxalate and silica with variable concentrations of magnesium, aluminium, potassium, phosphorus, sulphur, barium and manganese. Often found forming near or with lichens. Usually dark in colour, but can be as light as ivory	Oxalate patina, lichen-produced crusts, patina, scialbatura
Phosphate skin	Various phosphate minerals (e.g. iron phosphates or apatite) that are mixed with clays and sometimes manganese	Organophosphate film; epilithic biofilm
Pigment	Human-manufactured material placed on rock surfaces by people	Pictograph, paint, sometimes described by the nature of the material
Rock varnish	Clay minerals, Mn and Fe oxides, and minor and trace elements; colour ranges from orange to black produced by variable concentrations of different manganese and iron oxides	Desert varnish, desert lacquer, patina, manteau protecteaur, Wüstenlack, Schutzrinden, cataract films
Salt crust	The precipitation of sodium chloride on rock surfaces	Halite crust, efflorescence, salcrete

Table 39 Continued

General type	Description	Related terms
Silica glaze	Usually clear white to orange shiny lustre, but can be darker in appearance, composed primarily of amorphous silica and aluminium, but often with iron	Desert glaze, turtle-skin patina, siliceous crusts, silica-alumina coating, silica skins
Sulphate crust	Composed of the superposition of sulphates (e.g. barite, gypsum) on rocks; not gypsum crusts that are sedimentary deposits	Gypsum crusts; sulphate skin

infer long-term stability. Others have guessed at the ages of such features as flooding events on ALLUVIAL FANS, based on an intuitive feeling about the appearance of rock coatings (see gradual darkening of alluvial fan surfaces in the Plate 100). The complexities associated with formative processes have made rock coatings extraordinarily difficult to use as geomorphological tools to indicate either age or infer palaeoclimate. Rock coatings will be getting increased attention in future years as they are identified on Mars and as planetary scientists attempt to use rock coatings to infer Martian geomorphic processes (Kraft and Greeley 2000).

Rock coatings have applied significance in a variety of contexts. Heavy metal skins assist in identifying metal pollution (Dong *et al.* 2002). Some believe that artificial rock coatings have potential to aid in the conservation of priceless stone monuments (Borgia *et al.* 2001). Construction and development in desert regions contrasts bright uncoated rocks and darker natural rock coatings; the desire to live in natural-appearing settings leads to the application of artificial rock coatings to mimic natural colouration (Henniger 1995). Rock coatings, called patina in archaeology, are also used in the study of surface artefacts, rock paintings and rock engravings.

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Further reading

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SEE ALSO: alluvial fan; desert pavement; desert varnish; pediment

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