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Desert processes and Death Valley - 'Geography Explained' Fact Sheet

Location	Death Valley is in California. It is near the western border with Nevada, and is approximately 300km from Los Angeles. It is one of the many *desert basins* within the Sierra Nevada Mountains.
Climate	Death Valley is one region of the desert area of S.W. USA. Deserts occur here because of the *rain shadow effect*. Moisture-bearing winds from the west lose their moisture as they rise to cross the Sierra Nevada Mountain Range. When the air subsides into basins on the other side of the mountains, it has lost its moisture and becomes even drier. Thus there is little chance of cloud formation or rainfall in these desert basins. Death Valley has the reputation as the hottest and driest part of the USA.
Landscape	Death Valley is a low basin bordered in the east and west by mountain ranges. Much of the basin is below sea level. It has the distinction of having the lowest place in the USA – Badwater which is 222 feet (xxx metres) below sea level. The mountains that rise on each side of the basin are mostly bare rock without vegetation cover. They are severely eroded with hundreds of sharp ridges and valleys (called *badlands*). In the low-lying basin there are areas of sand dunes and areas of loose stones. However, the flat areas are dominated by *playa lakes* – large, dry lake beds of either salt or mud.
Playa Lakes	The largest playa (Death Valley Salt Pan) is one of the world's biggest playa lakes. It has a crust of salt overlaying mud, both of which are the remnant of material brought down to the lake by water at the few times of heavy rain. The water evaporates quickly and leaves the salt and mud behind. As well as the large Death Valley Salt Pan, there are numerous smaller playas. One of these is the Racetrack Playa.

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Racetrack Playa	Racetrack Playa is an almost perfectly flat playa lake. It is at a higher altitude than most of the playas - 1131 metres above sea level. It is almost perfectly flat. During periods of high rainfall, water flows down from the surrounding mountains, forming a shallow *ephemeral* (short-lived) lake. This water is evaporated quickly, leaving behind soft mud. The sun beats down and dries the mud, which cracks into a mosaic pattern of small polygons.
Racetrack Playa	 photo: Noel Jenkins
The mystery of the	Scattered across the Racetrack Playa are many boulders, some up to 320kg in weight, and many smaller pieces of rock. Each piece of rock has a grooved trail stretching behind the rock for as far as 880 metres.

sliding rocks	Clearly the rocks have moved across the mud, but no-one has ever seen one moving! Equally clearly, they must have moved when the mud was wet, to cause them to leave trails in the mud. There has been much scientific curiosity and research into the 'mystery' of these sliding rocks.
The scientific investigation	Geologist, geographers and other scientists have used a number of techniques of investigation: a. They measured each of the rocks and calculated their individual weights. They then mapped these to see if there was a specific pattern, such as bigger rocks in one area. b. They mapped the scars and trails of the sliding rocks to see patterns in these. Did they all move in the same direction or was the movement random? c. They investigated the area after rain to see what was happening when the lake was briefly flooded. d. They measured the wind speeds and wind directions at locations everywhere in the lake to look for spatial correlations between the tracks and the influence of the wind.
The results of the scientific investigation	Early investigators explained the phenomenon as the result of the rocks being embedded in an ice sheet in the coldest storms of winter. Being 1131 metres above sea level, the playa receives snow which freezes to a layer of ice at times. Ice rafts can form and it was thought that they could move across the playa lake with the rocks embedded in them. However, experiments to set up similar phenomena in 1996 did not fully support this theory. In 1998 investigators during an abnormally strong El Nino year with ice-sheets, did not show any movement of rocks from their mapped locations. Nevertheless, further measurements using very accurate GPS measurement instruments have found that there is a general movement trend towards the north-north east, which is the same direction that the prevailing winds move towards. Therefore, winds are the most likely cause of the trails in some way. The rocks seem to be propelled by the winds which have been made much stronger by being channelled through corridors in the south.
Map of trails	Maps such as the one above show that the trails are straighter in the south where the concentrated winds have just come out of the mountain passes. Further towards the north, the trails take more twists and turns, possibly because of wind vortices caused by friction with the ground surface and loss of speed.

Sand Dunes	In parts of Death Valley there are sand dunes (see photograph above). Dunes occur when windblown sand is able to accumulate. The particles of sand come from the erosion of rocks over millions of years and often the sand first accumulates in river beds and lake beds, and then is blown away. Dunes of different shapes occur because of the differences in the amount of sand and the direction of prevailing winds. For example, if the wind consistently blows from the same direction, *longitudinal dunes* (aligned with the wind) may occur. If the wind direction is inconsistent (as in parts of DeathValley) the dunes are more irregular.
Alluvial Fans	Where rivers come out of the mountain into flatter areas, such as the basin of Death Valley, alluvial fans are often formed. They are triangular areas of deposited silt. The silt has been brought down in the river from the mountains. When it reaches the flatter basin area, the river often spreads out, causing more friction with the ground. This slows down the water and the silt drops out of it. For most of the year the rivers are dry and the alluvial fan looks like a large triangle of deposited silt.
Canyons	There are no large canyons in Death Valley, but not far away is the largest of them all – the Grand Canyon. This is a deep and wide valley cut by the Colorado River, which flows all the year, supplied by water from the high mountains of Colorado. Because deserts have very shallow (if any) soil, the canyon walls are often bare rock, and the layers of rocks from different geological ages can be clearly seen.
Mesas and Buttes	These are no major areas of mesas and buttes in Death Valley, but there are some of the best examples in the world nearby in Monument Valley. A mesa is a table-top formation which is a small remnant of a former plateau. A butte is an even smaller remnant. The height of the mesas and buttes in an area is usually the same because they are all remnant pieces of the same plateau. Water erosion is the cause of mesas and buttes; the water from periodic storms and floods has cut along lines of weakness and removed most of the plateau, leaving only remnants of it. The mesas and buttes have probably survived because they have a harder layer of rock protecting their tops. If the mesas and buttes are eroded away even further, all that may be left are tall columns of rock called pedestals.
Gibber Deserts	There are some areas of Death Valley which are covered with small stones. Large desert areas covered by small stones are called gibber deserts. They are formed by the combination of weathering and erosion

	by water of the rock layer. In some desert regions the gibbers are blasted by sand caused by strong winds. When these have blown consistently for thousands of years, they may cause '*ventifacts'* (sand-blasted facets) on one side of the rocks. Sometimes the weathering of particular chemicals in the rock gives the stones a layer of reddish-brown '*desert varnish'*.