The formation of dunes in hot deserts

Hot deserts of various types occupy approximately a quarter for the Earth's land surface and are a major landscape component on most continents. Although many deserts are rocky rather than sandy, dunes and sand seas are common, and represent most people's image of arid zone geomorphology. The first requirement for the formation of a dune is sand. Perhaps surprisingly, given the close association of dunes and deserts, sand is almost invariably produced by the action of water. For example, sediment in the Namib sand sea in Namibia is transported to the Atlantic coast via the Orange River, which drains much of southern Africa. This material is then moved northwards by the Benguela Current before being moved onland by coastal processes and forming large longitudinal dunes. This sand is eventually washed into the Atlantic Ocean by the annual flood of the Kuiseb river, which forms the northern boundary of the Namib sand sea. In this example, the sand sea represents one part of a much longer and more complicated sediment transportation system which moves material from the interior of southern Africa to the Atlantic Ocean. Once a landscape contains sufficient sand to generate dunes, the shape of those dunes depends on the amount of sediment available, wind regime, climate and topography. Topography is important in the formation of dunes both by channelling sediment flow and providing relatively sheltered locations where sand can accumulate. Vegetation rapidly stabilises sandy landscapes, preventing dune movement, which is why coastal dunefields in the UK rarely extend far inland. In arid regions with monodirectional winds, dune shape changes from individual barchans to barchanoid ridges to transverse dunes as sediment supply increases. Where two dominant wind directions occur, longitudinal (linear) dunes form, and more complex wind regimes yield star dunes. Consequently it is possible to "read" the dunes in a desert landscape and understand both the wind regime and sediment supply status.