

and dolostone, are found intact, it is evident that the rock layers being viewed are giving us an accurate record of the cyclic deposition of sediments in that particular location.

6. The presence of relatively pure carbonate rock zones containing large numbers of the small, rounded carbonate particles we call ooids is significant. Such zones tell us that long periods of moderate agitation of water which was high in calcium carbonate content helped in the formation of the rock mass.

7. Any large mass of limestone which contains numerous sizes of carbonate particles, and contains little or no foreign material such as clay, quartz, or volcanic debris, can practically always be identified as having been formed in a natural setting of relatively calm waters. The absence of appreciable amounts of foreign matter shows that there was no bottom disturbance which would bring in foreign particles.

8. Wherever large dissolution cavities are found dissolved out of a covered layer of a limestone deposit in the sea, it is evident that that layer was once exposed to weathering for a long period of time and then re-submerged. The covering layer above the pocketed bed was added later, allowing more recent sediments to partially or completely fill the old cavities.

9. Any broad, separable layer in a body of limestone, found to have on its upper surface small cavities or tunnels due to boring by marine organisms, will be recognized as having existed for a considerable period of time as an exposed surface, after the layer had been lithified. Hard structures such as oyster shells and the calcareous tubes of marine worms, fastened to these surfaces, will give further testimony to the length of time the animals were able to work on the rock surface before the next layer was added.

10. When limestone from well cores, or from a thick bank of carbonate rock, is examined under magnification and found to contain delicate, uncrushed fossils, and small cavities which were present at the time when the sediment hardened, this indicates long periods of time. The lack of compaction shows that no appreciable weight of additional sediments was added until long after the layer in question was deposited. If the samples being examined show large amounts of calcium carbonate cement crystals in an orderly arrangement in some of the original spaces, this is further testimony of long intervals of time during which the crystals were being precipitated from circulating pore water. If the crystals are of dolomite rather than of calcium carbonate, this likely represents even more time.

At this point we can illustrate the use of some of these principles by considering the famous Redwall Limestone of the Grand Canyon. The rock formations which lie immediately above and below it will also be considered briefly, as they relate to the Redwall Limestone. As for the term "Redwall," this limestone is not actually red, except on its vertical surface in the canyon, where it is colored