What is the origin of carbonates in sedimentary rocks?

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Carbonate rocks are defined as rocks that contain more than 50% carbonate by weight. They are mainly limestone and dolomite.[1] Carbonates are considered chemical sedimentary rocks formed out of solution through various chemical processes. Most carbonates were deposited by physical processes such as debris flows during the Flood. These are mostly the fine-grained or mud deposits. Some form from the skeletons of microorganisms. Limestone, $CaCO_3$, is composed mainly of calcite or aragonite, different polymorphs of $CaCO_3$ with a different atomic arrangement. Dolomite is calcium and magnesium carbonate, $CaMg(CO_3)_2$. The rock is called dolostone, but geologists often refer to dolostone as dolomite. To be considered a dolostone, 50% of the carbonate must be the mineral dolomite. If the calcite has less, but a still appreciable amount of, Mg, it is considered a high Mg calcite.

Although estimates have varied, carbonates make up 20–25% of all sedimentary rocks.[2] Carbonates are quite variable and are often layered with or interbedded with other types of sedimentary rocks. They also form one of the main types of cement for sedimentary rocks. Carbonates are found as low as the Archean, but they are most abundant in the late Proterozoic and early Paleozoic rocks.[3] Much carbonate is also found in the Cenozoic.[4]

Huge thickness of inorganic carbonate precipitation challenges uniformitarians

Uniformitarian scientists have attempted to claim that many carbonates represent the accumulation of carbonate from organisms. However, they do have trouble explaining the carbonates that were deposited out of fluid solution or from mass flows of carbonate mud, especially those in the Precambrian that have abundant carbonates. Some of these fine-grained carbonates (micrite) are up to about 5,000 m thick.[5] Boggs states:

> "The most controversial carbonate deposits, however, are the huge volumes of nonfossiliferous carbonate mud (micrites) present in both the Precambrian and Phanerozoic stratigraphic record. … We have a more difficult time explaining the formation of Precambrian limestones … that, as far as we know, were deposited before the widespread appearance of calcium-secreting organisms."[6]

The dolomite problem

Dolomite can also be widespread and thick. It is more common in Precambrian rocks. Dolomite is sometimes associated with the so-called 'evaporites', particularly anhydrite or gypsum. Anhydrite is the same as gypsum but without water. It is known that dolomite has replaced limestone by the addition of magnesium ions in fluids moving through the limestone. It is also known that some dolomite was deposited directly as *primary* dolomite. However, the origin of primary dolomite is an unsolved problem for uniformitarianism:

> "Dolomites have been studied very extensively; therefore, in theory, we ought to understand their origin quite well. On the contrary, the origin of dolomites remains one of the most thoroughly researched but poorly understood problems in sedimentary geology. … It is these fine-crystalline dolomites that have created the so-called *dolomite problem*, which geologists have not been able to satisfactorily solve … . Elevated temperatures, exceeding 60°C, are required to produce stoichiometric dolomite in the laboratory … [emphasis in original]."[7]

Figure 1. Carbonatite from Brazil that also contains magnetite and olivine

Such dolomite defies the uniformitarian principle in that no primary dolomite of significance is being deposited today:

> "Where is dolomite being deposited today? Nowhere does dolomite seem to be forming on a large scale … . However, in recent years dolomite had been found, albeit in rather small volume, in a number of somewhat restricted environments."[8]

Some have suggested that microorganisms help precipitation dolomite,[9] but this is still under debate.[10]

Challenge also for creation scientists

The volume of carbonates and the origin of primary dolomite also present a challenge for creation scientists to explain. First, we need to establish whether the carbonates, especially the abundant Precambrian carbonates, are from the Flood or pre-Flood. I have argued that they were very likely deposited during the Flood.[11] For instance, microorganisms and raindrop imprints are found in Precambrian sedimentary rocks. Moreover, several rock types abundant in Precambrian sedimentary rocks are also found into the Paleozoic, as if there were no discontinuity at the Precambrian/Paleozoic contact. These include high organic black shales, quartz arenites (sandstones with greater than 95% quartz with generally rounded frost grains), and carbonate rocks.

Assuming the Precambrian sedimentary rocks are very early Flood rocks,[12] where would such a large volume of carbonate originate? One possibility is that the carbonates boiled up from the 'fountains of the great deep' either as carbonate dissolved in water or as an igneous rock. Another possibility is that on Day 3 God made great carbonate banks or continental shelves, which would have been a source of carbonate early in the Flood. A hint as to the possibility of the former is that some igneous intrusions in the past have released lava that is greater than or equal to 50% carbonate.[13] These are called 'carbonatites' (figure 1).[1] The other 50% of the lava has been found to have minerals composed of sodium, potassium, calcium, etc., and have been given such names as 'natrocarbonatite', a high sodium carbonatite, and 'Ca-carbonatite' which has high amounts of calcium. Carbonatites have a low viscosity like basalt lava.

Carbonatites are often thought of as very rare, since only one volcano has been observed erupting carbonatites today, Oldoinyo Lengai, in Tanzania.[13,14] However, this is not necessarily true for the past, with 500 fossil, non-erupting Ca-carbonatite volcanos discovered so far.[15] They are predominantly found in Africa. So, they must have been more common in the past, such as during the Genesis Flood.

The existence of carbonatites suggests they may have first been fluids and melts in the mantle:

> "Our study suggests that alkali carbonate fluids and melts could have commonly formed in the geological past … . Thus, alkali carbonate fluids and melts have been so far overlooked in the geological record because of the lack of previously detailed inclusion studies."[16]

The existence of past carbonatite eruptions suggests that carbonates very likely originated in the mantle or lower crust. This suggests abundant carbonates erupted early in the Flood from below the ground and were associated with the widespread volcanism in the 'fountains of the great deep'. This can possibly account for the abundant Proterozoic and Paleozoic carbonates. The heat of these eruptions may also have been responsible for the deposition of primary dolomite, which is found especially in Proterozoic and Paleozoic sedimentary rocks.

References

1. Neuendorf, K.K., Mehl, Jr, J.P., and Jackson, J.A., *Glossary of Geology*, 5th edn, American Geological Institute, Alexandria, VA, p. 97, 2005.
2. Boggs, Jr, S., *Principles of Sedimentology and Stratigraphy*, 5th edn, Prentice Hall, New York, p. 135, 2012.
3. Using the geologic column as a heuristic tool for identifying the relative vertical position of different formations in the rock record.
4. Clarey, T.L., Local catastrophes or receding Floodwater? Global geologic data that refute a K-Pg (K-T) Flood/post-Flood boundary, CRSQ **54**(2):100–120, 2017.
5. Pettijohn, F.J., *Sedimentary Rocks*, 3rd edn, Harper and Row, New York, p. 317, 1975.
6. Boggs, ref. 2, p. 152.
7. Boggs, ref. 2, p. 154.
8. Pettijohn, ref. 5, p. 365.
9. McKenzie, J.A. and Vasconcelos, C., Dolomite Mountains and the origin of the dolomite rock of which they mainly consist: historical developments and new perspectives, *Sedimentology* **56**:205–219, 2009.
10. Zhang, F., Xu, H., Shelobolina, E.S., Konishi, H., Converse, B., Shen, Z., and Roden, E.E., The catalytic effect of bound extracellular polymeric substances excreted by anaerobic microorganisms on Ca-Mg carbonate precipitation: implications for the 'dolomite problem', *American Mineralogist* **100**:483–494, 2015.
11. Oard, M.J., Raindrop imprints and the location of the pre-Flood/Flood boundary, *J. Creation* **27**(2):7–8, 2013; creation.com/raindrop-imprints-and-flood-boundary.
12. Oard, M.J. and Reed, J.K., *How Noah's Flood Shaped Our Earth*, Creation Book Publishers, Powder Springs, GA, 2017.
13. Bell, K. and Keller, J. (Eds.), *Carbonatite Volcanism: Oldoinyo Lengai and the Petrogenesis of Natrocarbonatites*, Springer-Verlag, New York, NY, 1995.
14. Fischer, T.P., Burnard, P., Marty, B., Hilton, D.R., Fürl, E., Palhol, F., Sharp, Z.D., and Mangasini, F., Upper-mantle volatile chemistry at Oldoinyo Lengai volcano and the origin of carbonatites, *nature* **459**:77–80, 2009.
15. Weidendorfer, D., Schmidt, M.W., and Mattsson, H.B., A common origin of carbonatite magmas, *Geology* **45**(6):507–510, 2017.
16. Guzmics, T., Berkesi, M., Bodnar, R.J., Fall, A., Bali, E., Milke, R., Vetlényi, E., and Szabó, C., Natrocarbonatites: a hidden product of three-phase immiscibility, *Geology* **47**:527–530, 2019.