

還元化学消磁による磁性鉱物の変化

Changes of magnetic minerals in reductive chemical demagnetization.

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Demagnetizations are important processes in paleomagnetism studies. Alternating Field demagnetization (AFD) and Thermal demagnetization (ThD) are two of the most popular techniques used. However, there are samples that those techniques would not work for erasing secondary magnetizations. In such a case, Chemical Demagnetization (CD) could be applied. It is widely used for paleomagnetic studies of redbeds, as the post-dated magnetic minerals may dissolve earlier. So it shall be effective for demagnetization of rocks with chemical remanent magnetization (CRM). Chemical demagnetization in most paleomagnetic studies has been performed using concentrated HCl solution, by leaching specimens for several months or for several days in high temperature. Those procedures have not been widely used because the handling of the high temperature HCl is difficult or time consuming for the room temperature. In addition, they destroy limestone samples and any other sedimentary rocks cemented by carbonate materials. In order to apply CD for limestones, we examined reductive etchant of neutral pH under the room temperature.

The magnetostratigraphy of reef limestone (Ryukyu Group) using the Reductive Chemical Demagnetization (RCD) is already reported in the 138th Society of Geomagnetism and Earth, Planetary and Space Sciences. Here we focus on the magnetic mineral changes in RCD, and magnetic properties of the minerals charring characteristic remanent magnetization.

The reductive etchants tried are potassium iodide (KI) solution and ascorbic acid (C₆H₁₂O₆) solution. The solutions are prepared in 5-20%, and for ascorbic acid (pH is about 2.4) the pH is buffered to 6.0-6.5 with sodium hydrogen carbonate (NaHCO₃). The redox potential of those cases is -150~-10mv. This condition falls in the domain of stable iron ion Fe²⁺ in the pH-pE diagram shown in Henshaw and Merrill (1980). After the leaching experiment in this condition, we performed various rock magnetism measurements.

As we wrote above chemical demagnetization in room temperature is very time consuming, drip-feeding of etchant is also tested. Drips of etchant is supplied from the top of the sample, and flows out from the bottom. The solvent (water) removes the solved Fe²⁺ faster.

We performed three experiments:

1) RCD of IRM: We compare the efficiency varying the etchants, concentrations and exposure method, in eight kind of solution (KI: 5, 10, 15, 20% ascorbic acid: 5, 10, 15, 20%) which supplied by dripping and dipping. The IRM is measured every 12 hours. The dripping enhances the demagnetization speed significantly, and shortens the duration up to a 9th of dipping RCD. In the eight kinds of solutions, the ascorbic acid 5% + NaHCO₃ (pH=6.52, ORP=-107mv) is the fastest, and the demagnetization is completed in 72 hours. Those experiments indicate RCD dipping the reductive etchant is most effective at least for those limestones.

2) IRM acquisition: The comparison of the IRM acquisition curves between before and after RCD indicate that the significant increase in saturating field, 3T and 1T, respectively, by RCD. It suggest that the RCD removes hematite and/or goethite, and remains magnetite intact.

3) Thermal demagnetization of a three-component IRM: Samples before and after RCD are exposed in 3T, 0.3T and 0.1T in each orthogonal direction, and then thermally demagnetized. It showed that a

high coercivity magnetic minerals was demagnetized by RCD. This indicate that at least considerable portion of the component demagnetized by RCD is carried by hematite. These results showed that the RCD is effective for carbonate rocks. We think that the reductive etchant make CD more versatile, as the ascorbic acid is easy to handle in the laboratory.

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