Fate of CO_2 leaked from seabed

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Models and Case Runs

We estimated the fate of CO_2 droplets leaked from seabed and the physiochemical impacts produced on seawater column by means of numerical simulations. The model (Chen *et al*, 2003) used in this study is a full two-phase small-scale turbulent ocean model, of which the submodels had been calibrated by both Lab. experiments and field observations. Predicted distances drops could move to from variant leakage depths (deeper than 800m) and initial drop sizes (*D*o mm) is shown in Fig.1. The water column impacts indicated by *p*H change are given in Fig.2 for cases of variant leakage rate (*M*, kg/s), *D*o, and current speed (*U*c m/s) at leakage time of one hour. The background ocean is Okinawa.

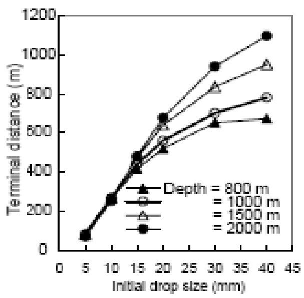

Fig. 1: CO_2 droplet fate

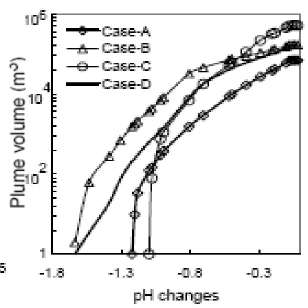

Fig. 2: Seawater impacts

Discussion of Results

The drop rising distances are almost linearly proportion to *D*o with a rate of 38m/mm and independent to the leakage depth if *D*o<15 and a rate increased from 10.3 to 24.7 as deeper leaked for large deformed drops. The maximum *p*H change can be reduced from 1.6 of Case B(*M*=0.6, *U*c=2.5,*D*o=8) to 1.2 by reducing *M*=0.1 (Case A) and 1.1 by a larger *U*c=25, (Case C). Smaller *D*o=5 produces a larger *p*H change, of which is balanced by a smaller *M*=0.3 (Case D).

Conclusions and Suggestions

At leakage depth larger than 800, no pure CO_2 is found to be able to reach to the ocean surface even at size as large as 40mm. Physiochemical impacts of leaked CO_2 on seawater can be reasonably estimated by using models developed with monitoring data of droplet plume height, from which the *D*o can be determined, and local leakage rate. For monitoring CO_2 drops leaked, acoustic sonar technology is a suggested method. For CO_2 leaked from shallow seabed, more Lab. data are expected for calibrating the models, such as bubble drag and shrinking rate.

References

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Zircon Lu-Hf isotope and its significance to ultra-high pressure metamorphic rocks from Dabie Terrain, Eastern China

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Zircon intragrain Lu-Hf and U-Pb isotope analyses were carried out for ultra-high pressure eclogite, jadeite quartzite and granitic gneiss from Shuanghe, Huangzhen and Xindian, Southern Dabie Terrane, Eastern Central China by using LA-MC-ICP-MS and SIMS (CAMECA) technique, respectively. The results show that zircon Hf isotope distributions are mainly controlled by the formation age of metamorphic precursor. Metamorphic zircon succeeded basically Hf isotopes of their protolith. The results also show systematic change among $^{206}Pb/^{238}U$ age, initial Hf isotopic compositions, Th/U and Lu/Hf ratios in zircons from different genetic domains. Metamorphic growth domains are characterized by low Th/U(<0.1), low Lu/Hf(<0.0005) and low $^{206}Pb/^{238}U$ ages, but high $^{176}Hf/^{177}Hf$ ratio relative to igneous core and mantle with partial recrystallization of pre-metamorphic ages. The low Lu/Hf and Th/U ratios of metamorphic growth zircon were caused by the decreasing of Lu and Th, and increasing of Hf, the high $^{176}Hf/^{177}Hf$ ratio originated from the addition of high radiogenic ^{176}Hf released from other high Lu/Hf minerals. The initial ratio of Hf isotope of metamorphic growth zircon may represent the Hf isotope composition of the whole rock at the same time. In some cases Hf isotope compositions of metamorphic and inherited zircons are undistinguishable within same range.

The trace of initial Hf isotope composition of ε_{Hf} and the Hf model age of depleted mantle T_{DM}, and U-Pb age for inhireted zircon core indicates that their age and origin are different for metamorphic precursor: Eclogite from Shaunghe show the source mixture of depleted mantle of 2.5Ga with at least 2.7Ga late Archean crust. The material for eclogite precursor from Huangzhen and Xindian was formed mainly by remelting of juvenile crust, with few old crust contamination. The material of gneiss precursor from both localities show same formation age and were derived from mixing of weak depleted mantle and crust. Whereas gneiss from Huangzhen shares the common source with eclogite. The zircon Lu-Hf isotopes of UHP metamorphic rocks from Dabie orogen reflects new crust growth during 0.7-0.8 Ga and 1.8-1.9 Ga, which was consistent with wide magmatism and tectonic setting of north margin of Yantze Craton.

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