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Hydrology and Earth System Sciences Discussions

Interactive comment on "Dissolved inorganic carbon export from carbonate and silicate catchments estimated from carbonate chemistry and $\delta^{13}C_{DIC}$" *by* W. J. Shin et al.

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This study aims to delineate the annual seasonal variations of carbon isotopes in springs and streams with distinctively different basement lithology - carbonate and silicate rocks - and to estimate the effects of various carbon exchange processes. This will definitely contribute to understanding of carbon dynamics in streams at base flow conditions in the headwater area. However, some additional information may be helpful to better interpret the results, say, mass balance of DIC and effect of seasonal variation of microbial activity in the soil zones, which are shown below for specific points.

Comment: It seems necessary to provide the proportion of cultivated land and major

crops in the study area because authors mentioned the effect of C4 plant such as corn. Also, if the cultivated land is significant, use of EC as a measure of "natural" mineralization may be hampered.

Reply: Land cover information in the studied catchments from various sources indicates that up to ~10% of the area is utilized as crop lands, although the exact types and distribution of crops are not available. As the reviewer pointed out, the crop distribution has two implications for the interpretation of the results. First, the distribution of C4 crops (mainly as corn) likely has an effect on d13C of DIC. However, the effect is not straight-forward mainly because of the agricultural practice. Usually, the entire plant (corn) materials are harvested and utilized for various purposes. This makes it difficult to trace the effect of C4 crops mainly by the distribution. The carbon isotope analysis of soil organic matter will help to evaluate the effect of C4-derived organic matter. Without the proper data for soil organic material, we take this as a part of uncertainties in our interpretation. We will add more discussion on the possible effect of C4 crops in section 4.1. Second, we used EC as the indication of weathering input from the soils. The possible effects of agricultural byproduct (e.g., fertilizers) in the interpretation of EC will be added in section 4.3 of the final draft of this paper.

Comment: It may be helpful to provide DIC variation over the sampling period because microbial activity may greatly differ in this mountainous area with thin soil depth and wider range of air temperature resulting in variation of total carbon budget in the soil zone and also, possibly, in groundwater. It seems that the carbonate spring have much higher DIC even the contribution of carbonate minerals is considered. If so, microbial activity in soil zone may greatly differ between silicate and carbonate area, which may have affect on the interpretation of the results.

Reply: Since we do not have proper data for the soil carbon dynamics, we interpreted groundwater DIC as an indication of various carbon exchange processes in soils. Seasonal variations in DIC were slightly different between silicate and carbonate springs. In the silicate spring, DIC variability was more remarkable with higher concentration during summer possibly associated with enhanced microbial activities in soils. On the other hand, DIC was less variable in the carbonate spring with the concentration being slightly lower in summer. We interpreted that the soil carbon dynamics were similar at both catchments and the strong buffering effect occurred in the waters at the carbonate catchment. Without enough information on the soil properties, we cannot elaborate this discussion further but the possible effect of the soil dynamics on DIC will be added at section 4.3 in the revised manuscript.

Comment: What about the seasonality of d13C in the silicate spring? Information of soil depths and vegetations may be useful, especially for comparison with carbonate springs.

Reply: We interpreted that the seasonality in d13C at the silicate spring was mainly due to the changes in microbial activities in soils in relation to temperature and precipitation (section 4.3). As discussed previously, data on soils are not available to properly discuss their effects.

Comment: For the interpretation of the seasonality of d13C in the carbonate spring, authors employed the difference in extents of exchange between atmosphere and soil zone as the cause of d13C variation. But, what about microbial activity in the soil zone which can widely differ with seasons? Also, how relevant is it to use Amiotte-Suchet et al. (1999) as a reference for that because their study area (France?) may have climate conditions different from this study area?

Reply: We interpreted that the d13C variability in the spring waters was mainly due to the soil dynamics related to the seasonal changes in microbial activities and precipitation regimes. This combined effect was visualized in pCO2 vs. d13C cross plot in the silicate spring and in EC vs. d13C cross plot in the carbonate catchment (section 4.3). Therefore, we totally agree on the reviewer's comment and discussed this aspect at the manuscript.

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