Precambrian paleosols and their information on weathering

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The first oxygen rise occurred sometime between 2.6 and 2.0 Ga. The most popular model of this rise is characterized by a drastic increase by 2 orders of magnitude at around 2.3 Ga. This model was obtained semiquantitatively by using the geochemical data of paleosols. Accurate understandings of weathering in the Precambrian are required to apply such geochemical data to the estimation of atmospheric oxygen concentrations. We examined complied data of Precambrian paleosols to understand Precambrian weathering.

The compaction factor (CF), defined as the fraction of the original thickness, is a good indicator to understand the intensity and formation time of weathering which are expressed as the intensity of mineral dissolution in a weathering profile. The retention fraction (MR) is a fraction of an element (M) in paleosol to parent rock on isovolumetric basis after corrected by CF. The CF values were found to be linearly proportional to SiR values. Because Si dissolution is representative of that of silicate minerals, it will be proportional to the intensity of mineral dissolution, and therefore, CF is also proportional to the intensity of mineral dissolution. On the other hand, the FeR and MnR values were not correlated to the CF values. When FeR was plotted against age, it increased gradually between 2.5 and 2.0 Ga and was about 1 since 2.0 Ga. This suggests the oxidation rate was getting faster in the time period reflected by the oxygen rise. However, FeR is affected not only by the oxidation rate but also by the intensity of mineral dissolution, and thus, by CF. Our examination of the Fe2+R and Fe3+R values has revealed that FeR is affected by CF when the oxidation rate is slow but not significantly when the oxidation rate is fast. Therefore, FeR should be used in a limited range of CF values when the oxidation rate is slow