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A river based stable isotope record of orographic precipitation: Taurus Mountains, south central Turkey

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Reconstructing continental precipitation and vegetation patterns has become one of the most rapidly growing fields in terrestrial paleoclimate research. Furthermore, stable isotopes in precipitation within continental plateau regions represent an increasingly important tool for reconstructing the various effects of uplift related climate change within the world's largest plateau regions. With peak elevations of more than 3,000 m the Taurus Mountains represent the southern margin of the central Anatolian plateau and must have played a pivotal role in controlling the drainage and sedimentation patterns within the plateau interior. However, their surface uplift history remains largely elusive.
We sampled a series of tributaries and rivers along the Ermenek valley that crosscuts the Taurus Mountains in Southern Turkey. The aim of this study is to quantify the modern effect of orographic rainout of the Taurus Mountains on the d18O and dD values of river and spring waters and to compare these values to the d18O and dD of recent precipitation gathered by the Global Network of Isotopes in Precipitation (GNIP). Further we try to study the trends of the recent d18O and dD isotopic composition of local rivers and precipitation in the area to create a set of isotopic data that is comparable to isotopic studies on paleosoils and can therefore be used in future paleoaltimetry and paleoclimate studies.
We sampled 6 individual rivers during the fall season 2008 to capture mostly groundwater runoff in the south central Taurus Mountains. All sampled rivers belong to the same local drainage system which drains into the Mediterranean Sea. The total elevation difference within the sampling area exceeds 2,000 m and we were able to collect samples over almost 1,800 m of elevation.
Our measurements show that both d18O and dD values follow the same basic trend. d18O and dD values decrease systematically with increasing elevation. The lapse rate of d18O is about -2.2 per mil/km, whereas the lapse rate of dD is about -20 per mil/km. Select samples have higher d18O and dD values than expected for their respective elevations due to strong evaporative effects at the sampling sites. In areas of very steep topography (waterfalls, valley gorges) the d18O and dD values of water samples are biased towards values lower than expected for their respective elevations. However, such irregularities can be accounted for by plotting the measured isotopic compositions against the hypsometric mean elevations instead of the actual sampling elevations.
Comparison with data gathered by the GNIP network at four neighboring stations (Adana, Antalya, Güzeloluk, and Kocebeyli) shows that the longer-term (1 to 18 years) isotopic composition of precipitation agrees very well with the data collected in this study. Collectively, the data presented here may serve as a modern template against which late Neogene proxy-based records of paleoprecipitation along the southern margin of the central Anatolian plateau may be calibrated.