Changes in soil organic matter abundance and molecular composition in an arid ecosystem in response to long-term elevated CO_2

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Arid and semi-arid ecosystems cover more than 40% of Earth's land surface, yet little is known about how soils will respond to rising atmospheric CO_2 concentration. Previous work in the Mojave Desert reported higher soil organic carbon (SOC) and total nitrogen (N) concentrations following 10 years exposure to elevated atmospheric CO_2 at the Nevada Desert Free-Air-Carbon dioxide-Enrichment Facility (NDFF). In this study, we investigated potential mechanisms that resulted in increased SOC and total N accumulation and stabilization using high resolution mass spectrometry at the NDFF site. Samples were collected from soil profiles to 1 m in depth with a 0.2 m a increment under the dominant evergreen shrub *Larrea tridentata*. The differences in the molecular composition and diversity of soil organic matter (SOM) were more evident in surface soils and declined with depth. Our molecular analysis also suggested increased root exudation and/or microbial necromass from stabilization of labile C and N contributed to SOM and N stocks. Increased microbial activity and metabolism under elevated CO_2 compared to ambient plots suggested that elevated CO_2 altered microbial carbon (C) use patterns, reflecting changes in the quality and quantity of SOC inputs. Our results suggest that arid ecosystems are a potential large C sink under elevated CO_2, give the extensive coverage of the land surface, and that labile compounds are transformed to stable SOM via microbial processes. Arid systems are limited by water, and thus may have a different C storage potential under changing climates than other ecosystems that are limited by nitrogen or phosphorus.