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The characteristics of atmospheric trace elements input into East Antarctica as recorded in GV7 snow pit

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A series of 60 snow samples covering 4.5 years from 2009 to 2013 were collected from the 3.0 m deep snow pit at GV7 site (70° 41' 17"S, 158° 51' 49"E, 1950 m asl), East Antarctica. These samples were analyzed for aluminum (Al), arsenic (As), manganese (Mn), lead (Pb), scandium (Sc), strontium (Sr), vanadium (V) and zinc (Zn) in order to characterize the relative contributions from natural and anthropogenic emissions to the fallout of these elements in East Antarctica. The mean concentrations of most of these elements are very low at the pg g-1 level, and differ by orders of magnitude from one element to another ranging from 0.10 pg g-1 for Sc to 232 pg g-1 for Al. The Al concentrations which represent atmospheric mineral dust input display high concentrations during summer seasons. The Al concentrations are highly correlated with Mn (r2=0.82), Sc (r2=0.83) and V (r2=0.76), and moderately correlated with As (r2=0.30), Pb (r2=0.41) and Zn (r2=0.15). This implies that atmospheric deposition of these elements in East Antarctica is closely related to atmospheric transport of crust dust. Crust enrichment factors (EFc) defined as concentration ratios between elements and Al in snow samples normalized with those in upper continental crust are relatively high for As (mean EFc=287), Pb (mean EFc=80) and Zn (mean EFc=104) representing these elements are largely enhanced by anthropogenic emission such as non-ferrous metal production and fossil fuel combustion. Meanwhile, EFc for Mn (mean EFc=6.8), Sc (mean EFc=11.7) and (mean EFc=4.3) are close to unit indicating these elements primarily originate from crust dust. However, temporal increases in EFc of Mn, Sc and V particularly during winter season imply long-range transport of anthropogenic emissions depending on seasonal air circulation patterns. Differently from other elements, Sr concentrations show high correlation with Na+ concentrations (r2=0.59) rather than those of Al (r2=0.0004). Combining with high EFc of Sr (mean EFc=30), this strongly suggests that atmospheric Sr over GV7 site, East Antarctica, has sea-salt origin.