



**Fig. 7.** Varimax-rotated PCA loading plot for standardized hydrochemical variables measured in the Lena River main stem (n = 27). Rotated components 1 and 2 explain 23% and 13% of total variance, respectively (36% cumulative). Colored envelopes are visual guides to broad geochemical associations inferred from the loadings and independent geochemical evidence: orange, mobile weathering- and groundwater-related solutes; green, DOC, nutrients, and mixed surface-derived variables; blue, low-solubility lithogenic and colloid-associated elements. Overlap among envelopes and variables outside them emphasize that the ordination is exploratory and does not represent statistically discrete clusters.

