O OH HO OH C04659 C04112

(a)

$$H_3$$
 CO4659 C04112

(b)

 H_3 CO400011

(b)

 H_4 CO7090

 H_5 C07090

(c)

 H_5 C07090

 H_6 C07090

(d)

 H_6 C04112

(e)

Figure S1. Reactions catalyzed by muconate cycloisomerase (KEGG Orothlog K01856). All five reactions are found in all samples in the metagenomics samples from the Antarctic deep lake and Alaska permafrost studies. KEGG reactions: (a) R05300; (b) R05390; (c) R06989; (d) R08116; (e) R09229.