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Mantle xenoliths in space and time in Europe

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The European continent is particularly rich in localities in which mantle xenoliths have been brought to the surface, representing lithosphere from beneath regions of crust of Archaean to Phanerozoic age. Cratonic lithosphere is represented by rare xenoliths from a few scattered localities in the Fennnoscandian shield (Finland, Arkhangelsk, Kola) and the East European platform (Belarus, Ukraine), where depleted garnet and spinel peridotites are brought to the surface mostly in kimberlites. More studies need to be undertaken concerning the nature of the lithosphere beneath the cratonic terranes of Europe (Fennoscandia, Ukraine, NW Scotland) and the processes that have formed it. Alkali basalts in Scotland and southern Scandinavia provide samples of somewhat younger (Proterozoic-early Palaeozoic) lithosphere. In the Tertiary and Quaternary alkaline volcanics erupted in the Hercynian and Alpine regions of western and central Europe, mantle xenoliths are abundant, but the processes that have affected the mantle in these areas are very diverse. Extreme depletion in Zr and Hf in clinopyroxenes associated with unusually high Hf-isotope ratios in mantle xenoliths from the Massif Central indicate that some regions of the lithospheric mantle have been extremely depleted by melting in Hercynian times. More constraints are needed on the age of depletion across different regions of Europe. Enrichment due to subduction-derived fluids has been suggested by various workers for regions of the mantle beneath the Pannonian-Carpathian region, the Dinarides, Spain and central Italy. Carbonatite metasomatism has been detected in xenoliths from the Pannonian-Carpathian region, NE Spain, central Italy, Poland and France. Silicate melt metasomatism is common beneath most regions, often giving rise to composite peridotite-pyroxenite or peridotite-hornblendite xenoliths. We need to have an agreed methodology to determine the degree of depletion of the mantle in different regions and an agreed set of criteria to distinguish

between different types of metasomatism. There are still some fundamental questions about how enrichment really occurs within xenoliths (i.e. to what extent interaction with magma prior to entrainment overprints many samples), and the extent to which the subcontinental lithospheric mantle participates in magmagenesis.