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TITLE: Hydrate occurrence in Europe: A review of available evidence

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ABSTRACT:

Large national programs in the United States and several Asian countries have defined and characterised their marine methane hydrate occurrences in some detail, but European hydrate occurrence has received less attention. The European Union-funded project ?Marine gas hydrate ? an indigenous resource of natural gas for Europe? (MIGRATE) aimed to determine the European potential inventory of exploitable gas hydrate, to assess current technologies for their production, and to evaluate the associated risks. We present a synthesis of results from a MIGRATE working group that focused on the definition and assessment of hydrate in Europe. Our review includes the western and eastern margins of Greenland, the Barents Sea and onshore and offshore Svalbard, the Atlantic margin of Europe, extending south to the northwestern margin of Morocco, the Mediterranean Sea, the Sea of Marmara, and the western and southern margins of the Black Sea. We have not attempted to cover the high Arctic, the Russian, Ukrainian and Georgian sectors of the Black Sea, or overseas territories of European nations. Following a formalised process, we defined a range of indicators of hydrate presence based on geophysical, geochemical and geological data. Our study was framed by the constraint of the hydrate stability field in European seas. Direct hydrate indicators included sampling of hydrate; the presence of bottom simulating reflectors in seismic reflection profiles; gas seepage into the ocean; and chlorinity anomalies in sediment cores. Indirect indicators included geophysical survey evidence for seismic velocity and/or resistivity anomalies, seismic reflectivity anomalies or subsurface gas escape structures; various seabed features associated with gas escape, and the presence of an underlying conventional petroleum system. We used these indicators to develop a database of hydrate occurrence across Europe. We identified a series of regions where there is substantial evidence for hydrate occurrence (some areas offshore Greenland, offshore west Svalbard, the Barents Sea, the mid-Norwegian margin, the Gulf of Cadiz, parts of the eastern Mediterranean, the Sea of Marmara and the Black Sea) and regions where the evidence is more tenuous (other areas offshore Greenland and of the eastern Mediterranean, onshore Svalbard, offshore Ireland and offshore northwest Iberia). We provide an overview of the evidence for hydrate occurrence in each of these regions. We conclude that around Europe, areas with strong evidence for the presence of hydrate commonly coincide with conventional thermogenic hydrocarbon provinces.

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