Selected Features of Giant Fields, Using Maps and Histograms

By

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Introduction

AAPG Memoir 78, Giant Oil and Gas Fields of the Decade 1990-1999, contains a CD-ROM (Horn, 2003) with tabulation, in thirty columns in EXCEL format, of information for each of 877 giant fields discovered in the period 1866-2003. This tabulation, which has recently been updated to 2004 (Horn, 2004), now includes 910 giants (500 million barrels of oil, 3 trillion cubic feet of gas, or equivalent in ultimate recovery). As part of the update, the interactive Microsoft mapping program MapPoint was utilized for presenting 68 maps of sedimentary provinces maps, an example of which is shown in Figure 1.

In this presentation, analysis of the tabulation of the giant fields is extended by examining in detail certain parameters given in the compilation. Specifically, maps (again using MapPoint), as well as EXCEL frequency histograms, are the means of summarizing major features. Since MapPoint is an interactive program, a myriad of examples could have been prepared for this "tour."

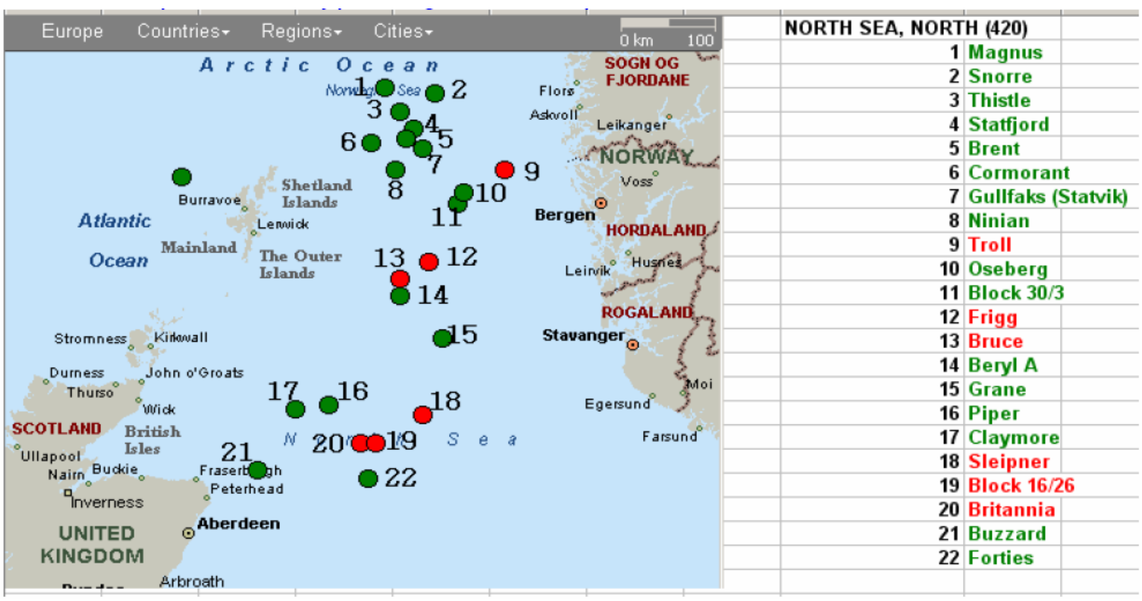

Figure 1. Locator map of giant oil and gas fields, based on sedimentary province--in this example North Sea, North (420) (from Horn, 2004 [Giant Oil and Gas fields 1868-2004--on CD-ROM]).

Seven examples using 25 maps and/or histograms are presented here. The reader is encouraged to explore some of the other possibilities by utilizing MapPoint (which complements EXCEL and is readily available from Microsoft) to generate maps using the data on the CD-ROM that accompanies Memoir 78 or the revised version.

Example 1: Location Of Giant Oil And Gas Fields

Figure 2 is a global map of the oil and gas giants. Green represents oil fields and red represents gas fields. Figure 3 shows, at a larger scale, the Middle East sector of this map. Note the separation of the oil and gas fields into specific sub-sectors. A similar separation of oil and gas provinces is present in West Siberia, as shown in Figure 4.

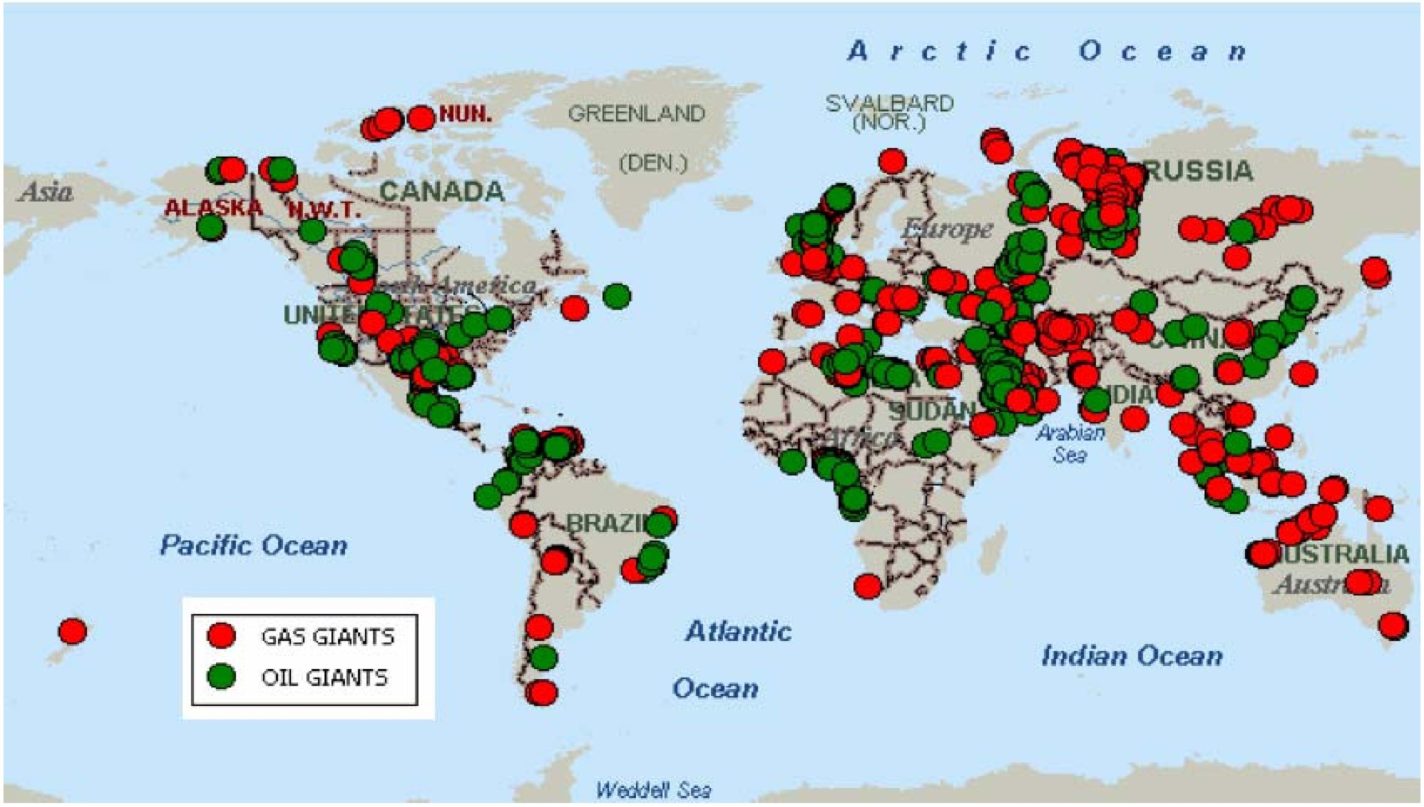

Figure 2. Global map of giant oil and gas fields. Green represents oil fields, and red represents gas fields.

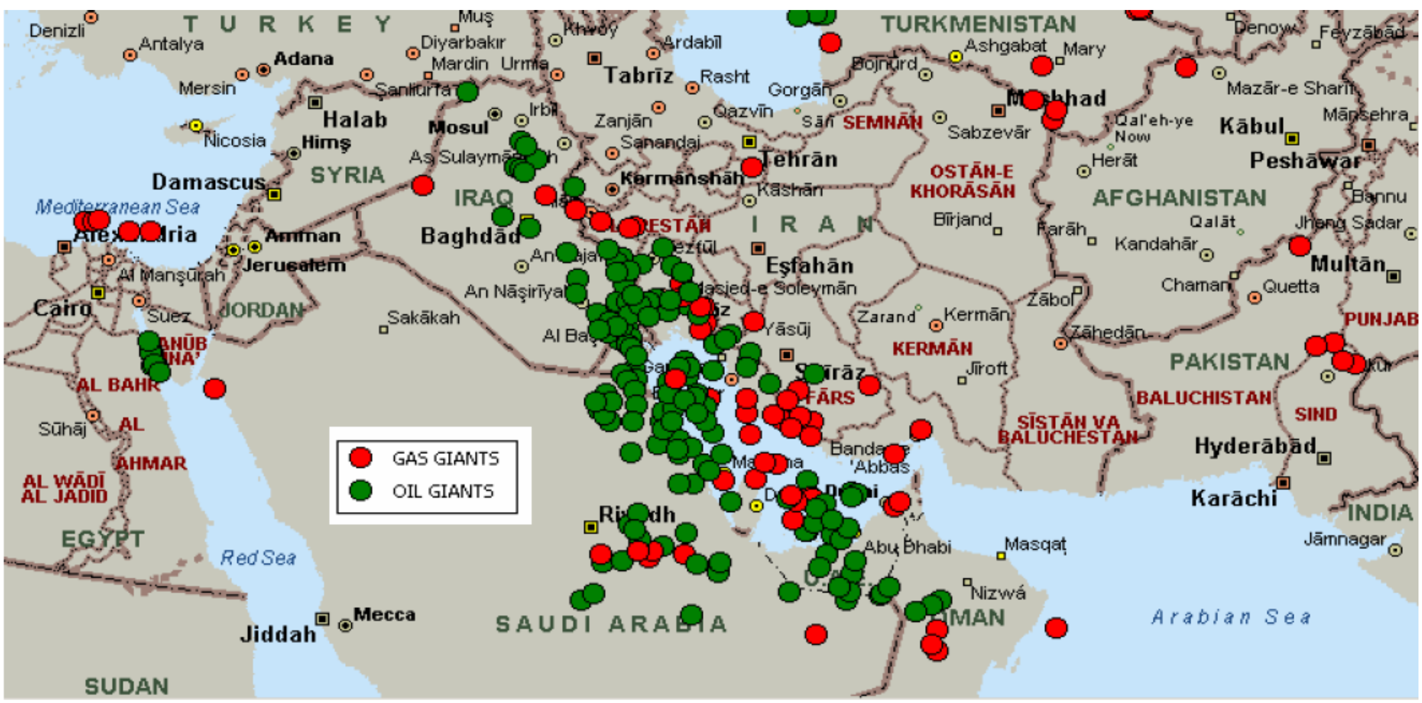

Figure 3. Middle East sector of the map of giant oil and gas fields.

Figure 4. West Siberian giant oil and gas fields.

Example 2: Discovery Year.

As noted above, the compilation of giant fields (Horn, 2003, 2004) includes all fields with ***ultimate*** recovery of 500 million barrels of oil, 3 trillion cubic feet of gas, or the equivalent. However, this compilation may be misleading if one seeks information with regard to ***present*** oil and gas reserves derived from the giant fields. For example, a giant with an ultimate recovery of 1000 million barrels equivalent discovered in 1930 is of significantly less importance from a resource standpoint than a giant with an ultimate recovery of 1000 million barrels equivalent discovered in 1990. The discovery year is thus a key to relative importance today, as discussed in more detail in the next example.

Even so, in itself, a map of the discovery year for giant fields (Figures 5) is interesting since it provides an historical perspective of the relative shifts of the oil and gas industry during the last 150 years, A frequency histogram (Figure 6) shows that giant oil and gas discoveries peaked 31 to 45 years ago.

Example 3: Ultimate Recoverable, Remaining, and Depleted Reserves

Figure 7 is sized pie chart showing estimate of remaining recoverable and depleted reserves, both in MMBOE, in giant fields of North America. The sum of remaining and depleted reserves is ultimate recoverable. As described in Memoir 78 (CD-ROM, C. Appendix, 1. Contents), for each field, the estimate of remaining equivalent reserves is based on an exponential decline of 3.4% (equivalent to a half-life of 20 years). Decline is computed as starting seven years after discovery, although exceptions are taken into account, such as in the Canadian Arctic.

Figures, 8, 9, and 10 illustrate, respectively, similar sized pie charts for the North Sea, portions of Europe, Asia and Africa, and Brazil.

Figure 11 is a frequency histogram of field size based on ultimate recoverable. As expected, it shows a predominance of fields with ultimate recoverables of 500-1000 MMBOE. Figure 12 is a frequency histogram of field size based on remaining reserves, showing an overwhelming predominance of fields with less than or equal to 1000 MMBOE. In fact, 380 fields have remaining reserves of less than 320 MMBOE and 535 fields have less than 500 MMBOE.

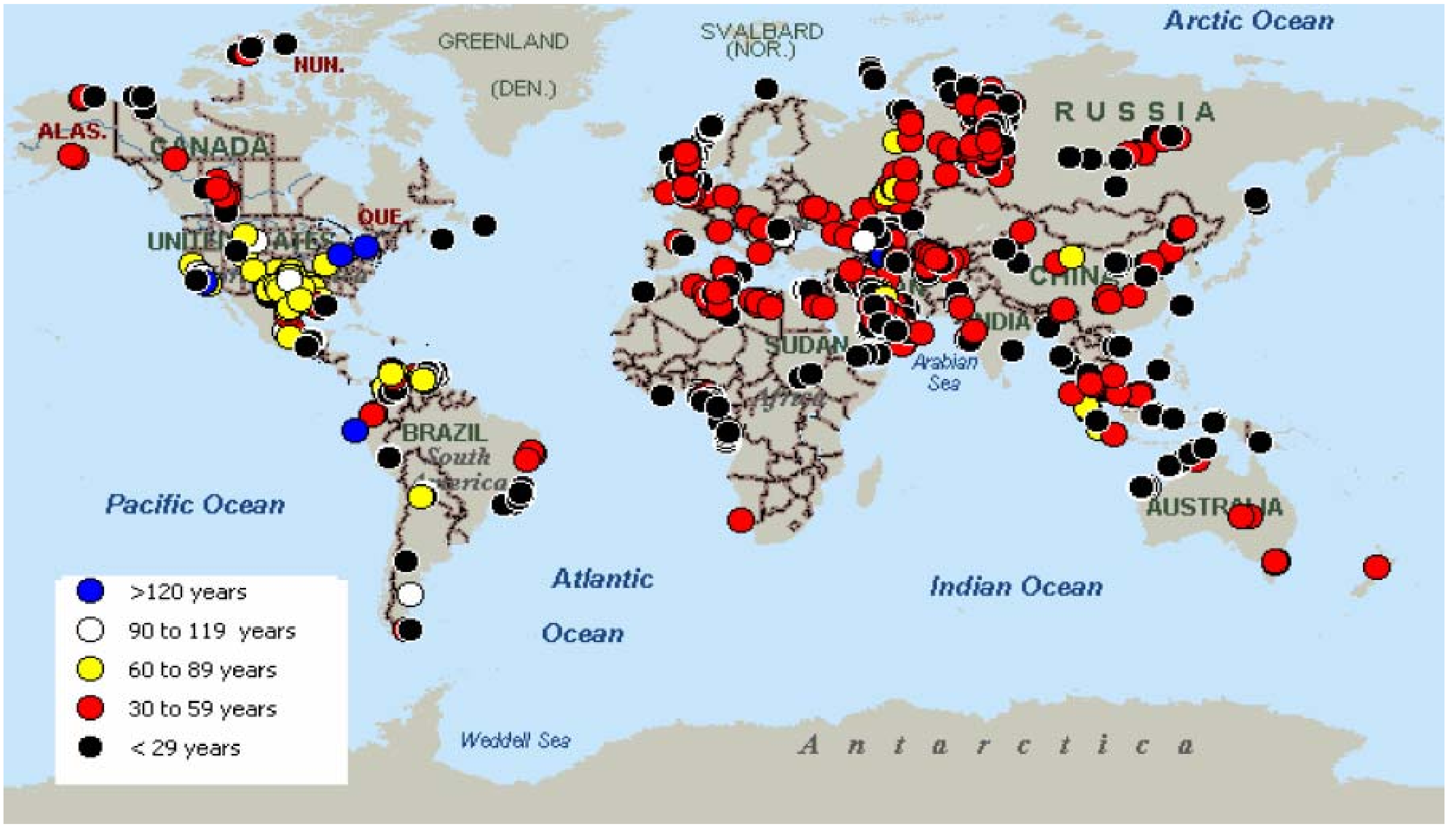

Figure 5. Map of giant fields, categorized according to years since discovery.

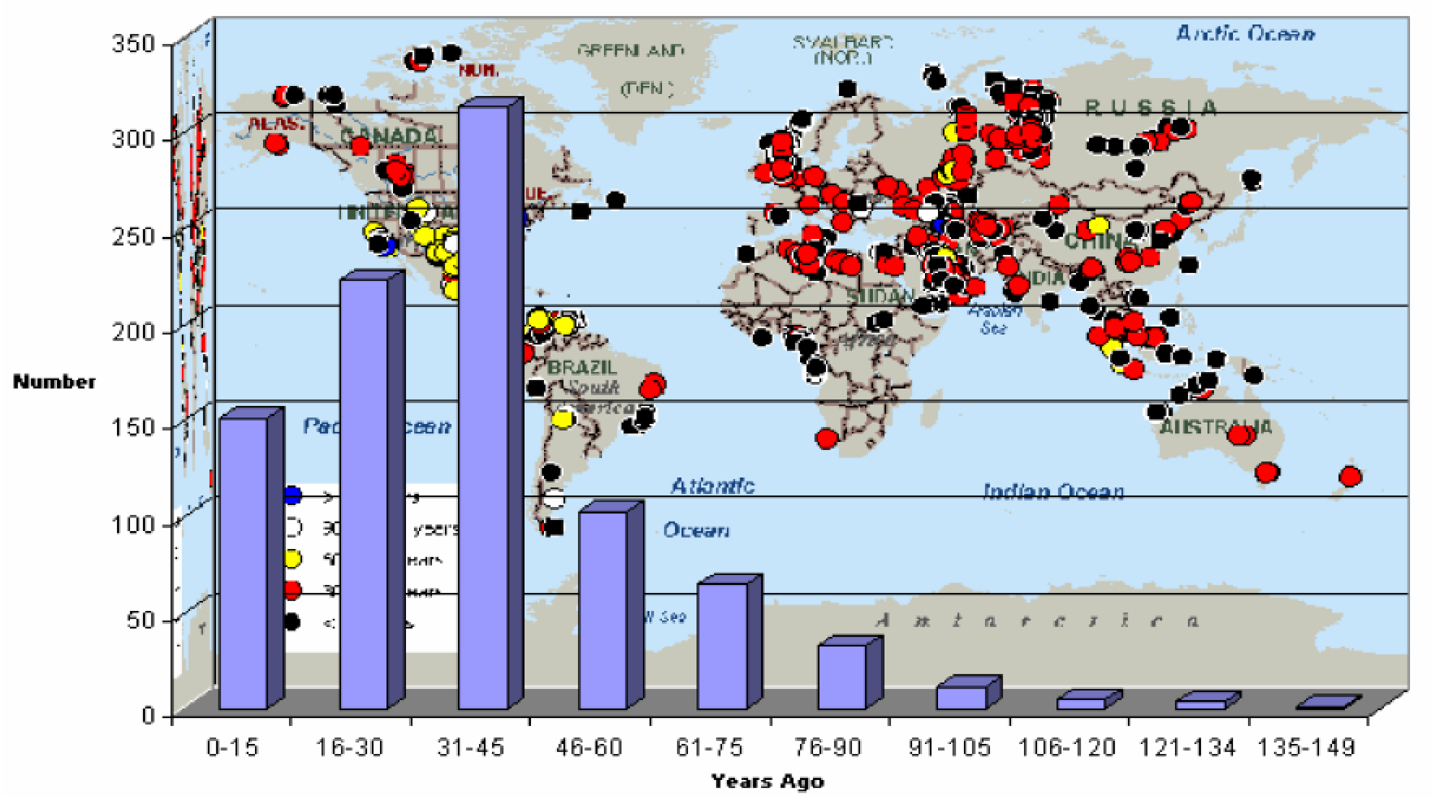

Figure 6. Frequency graph of giant fields in years since their discovery.

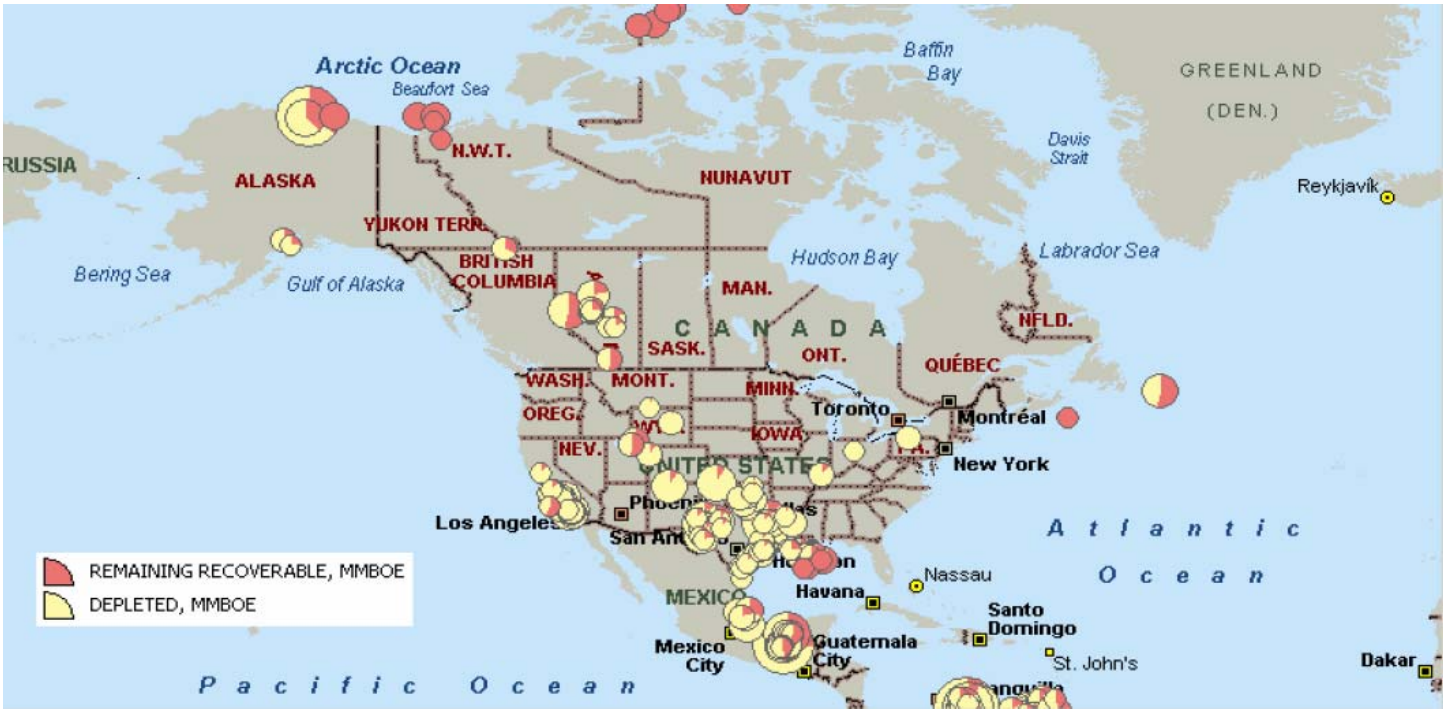

Figure 7. Sized pie chart showing estimate of remaining recoverable and depleted reserves, in MMBOE, in North American giant fields. The sum of remaining and depleted is ultimate recoverable.

Figure 8. Sized pie chart showing estimate of remaining recoverable and depleted reserves, in MMBOE, in North Sea giant fields.

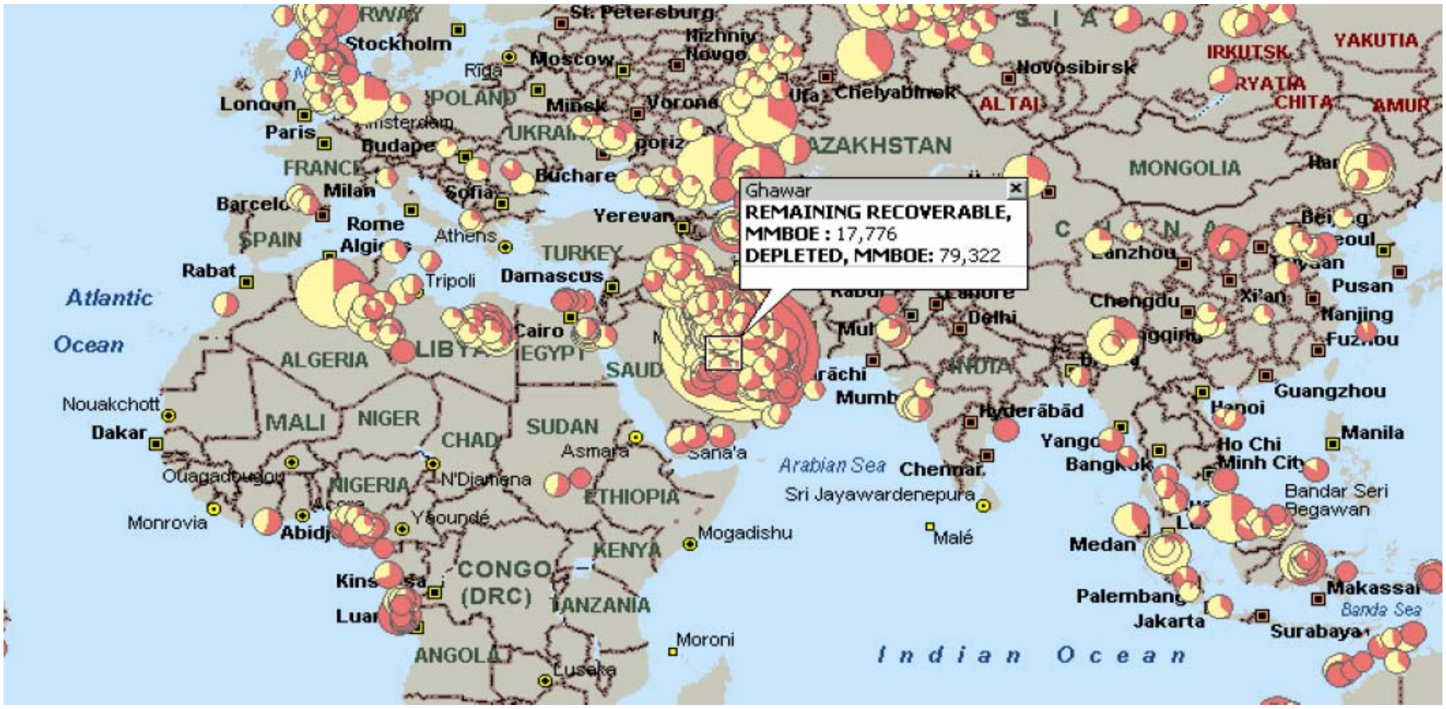

Figure 9. Sized pie chart showing estimate of remaining recoverable and depleted reserves, in MMBOE, in giant fields in portions of Europe, Asia, and Africa, with specific data provided for Ghawar field.

Figure 10. Sized pie chart showing estimate of remaining recoverable and depleted reserves, in MMBOE, in giant fields in offshore Brazil, with specific data provided for 1-RJS-539 field.

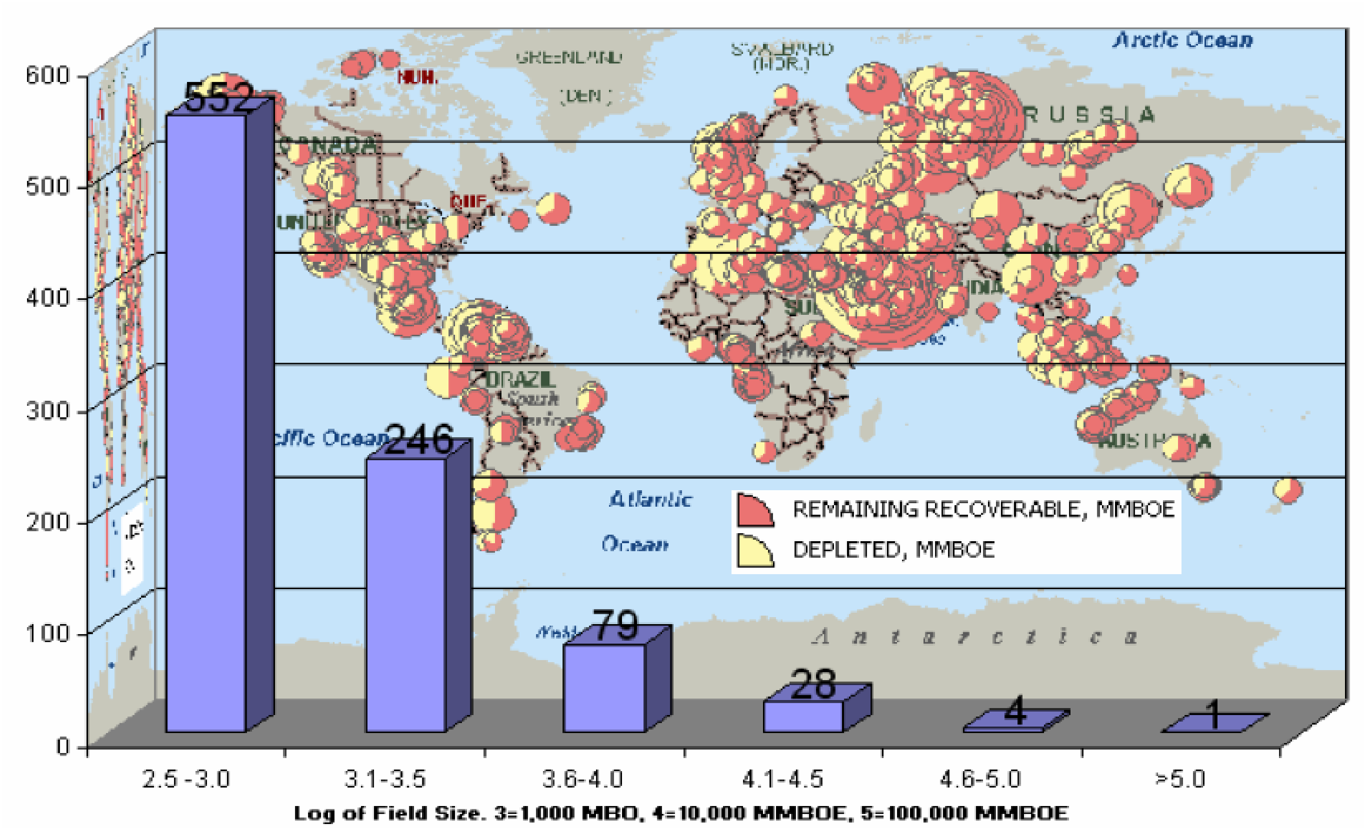

Figure 11. Frequency histogram of the ultimate recovery of giant fields.

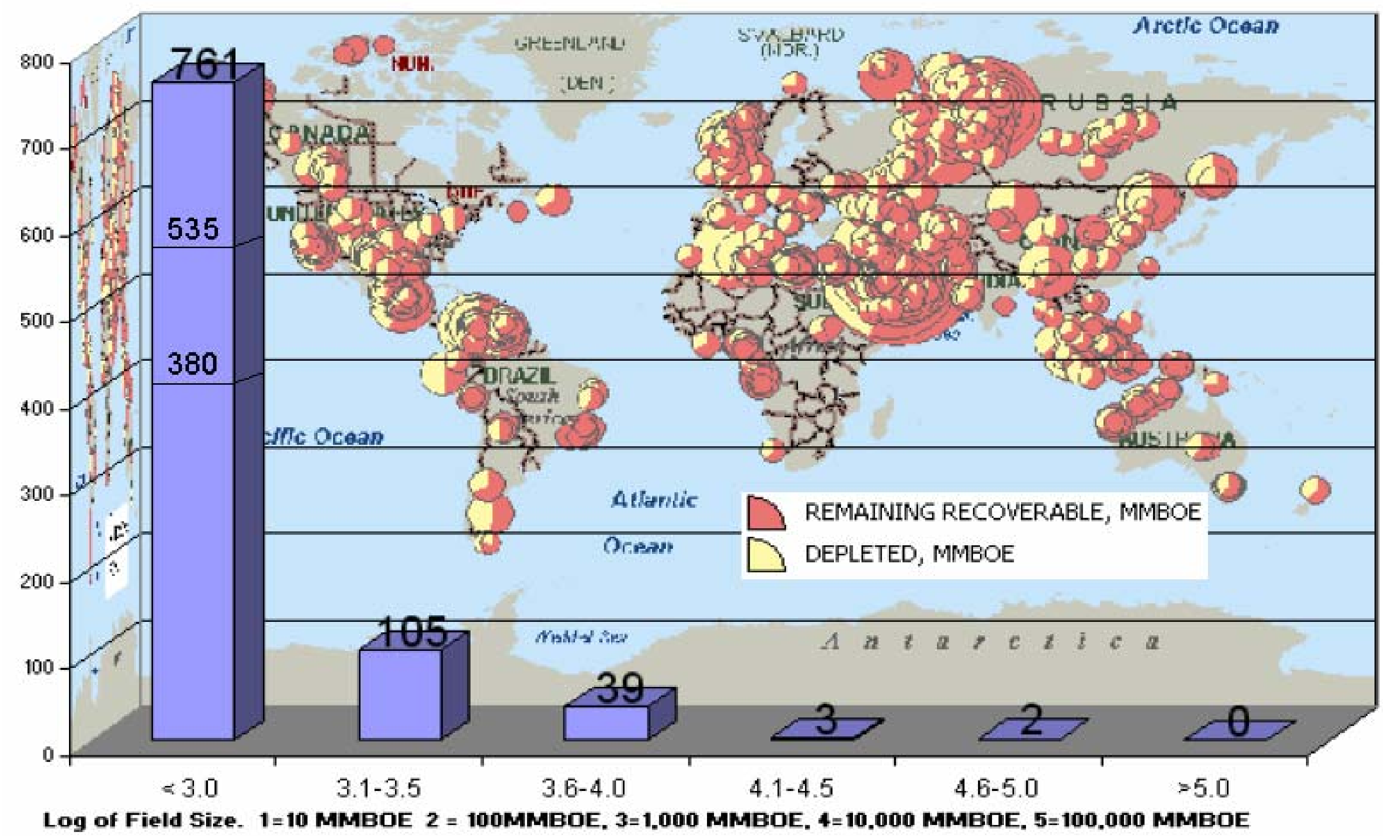

Figure 12. Frequency histogram of remaining reserves of giant fields, using, in large measure, the same intervals as those for ultimate recovery (Figure 11). 380=fields <320 MMBOE and 535=fields <500 MMBOE.

Example 4: Lithology

Figures 13, 14, 15, and 16 are maps of the reservoir lithology in giant fields, respectively, of the Eastern Hemisphere, North America, South America, and northern South America, with the last example utilizing the “zoom “ feature of MapPoint. Note the lithology bands in the figures, especially Figure 13. Also note the preponderance of carbonate reservoirs in the Middle East and of clastic reservoirs in the giant fields of South America.

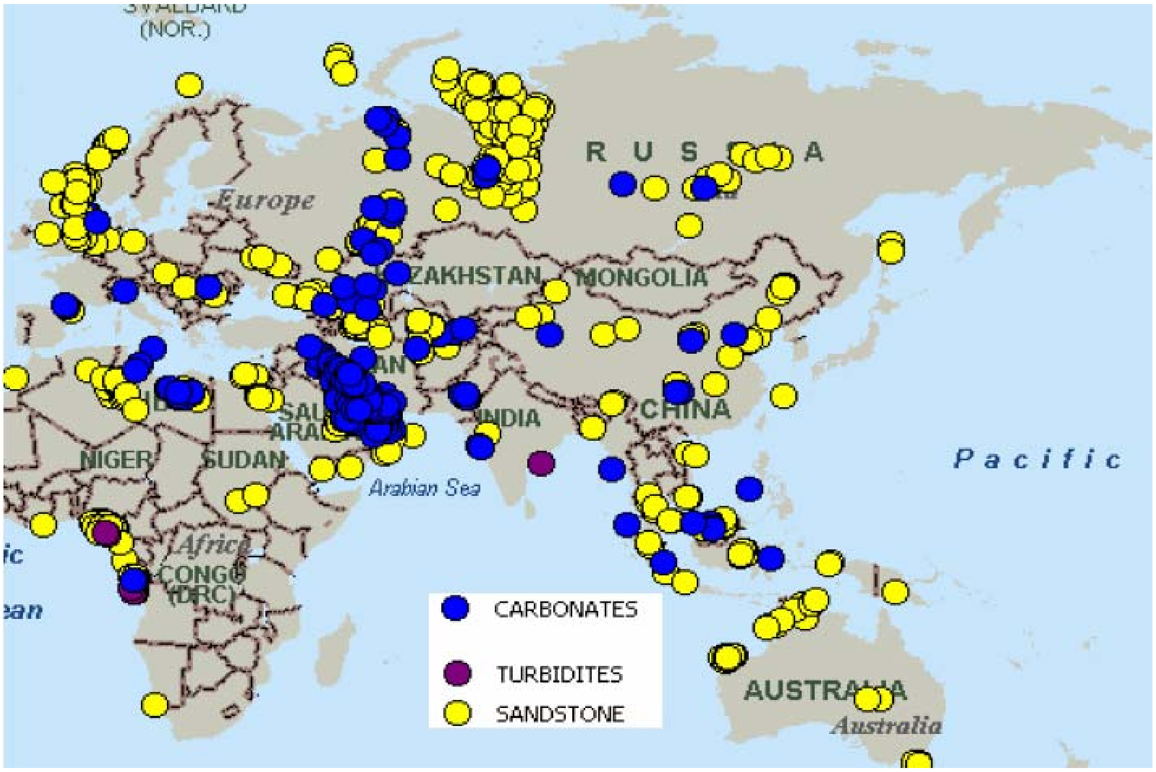

Figure 13. Map of reservoir lithology in giant fields of the Eastern Hemisphere.

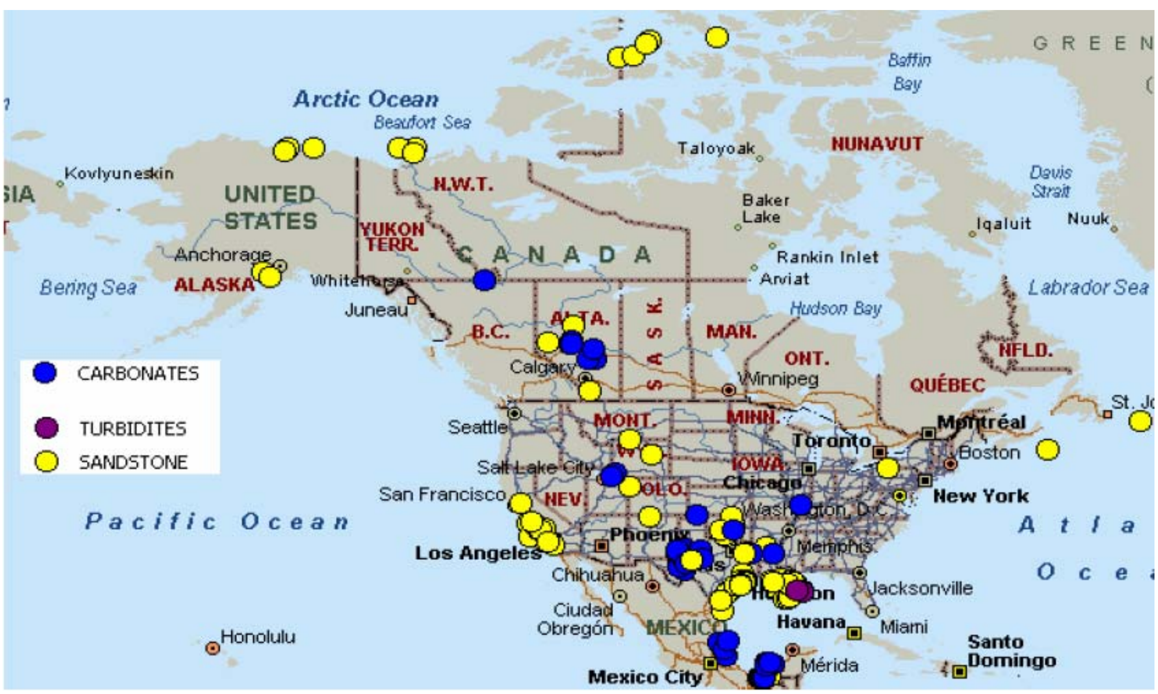

Figure 14. Map of reservoir lithology in giant fields of North America.

Figure 15. Map of reservoir lithology in giant fields of South America.

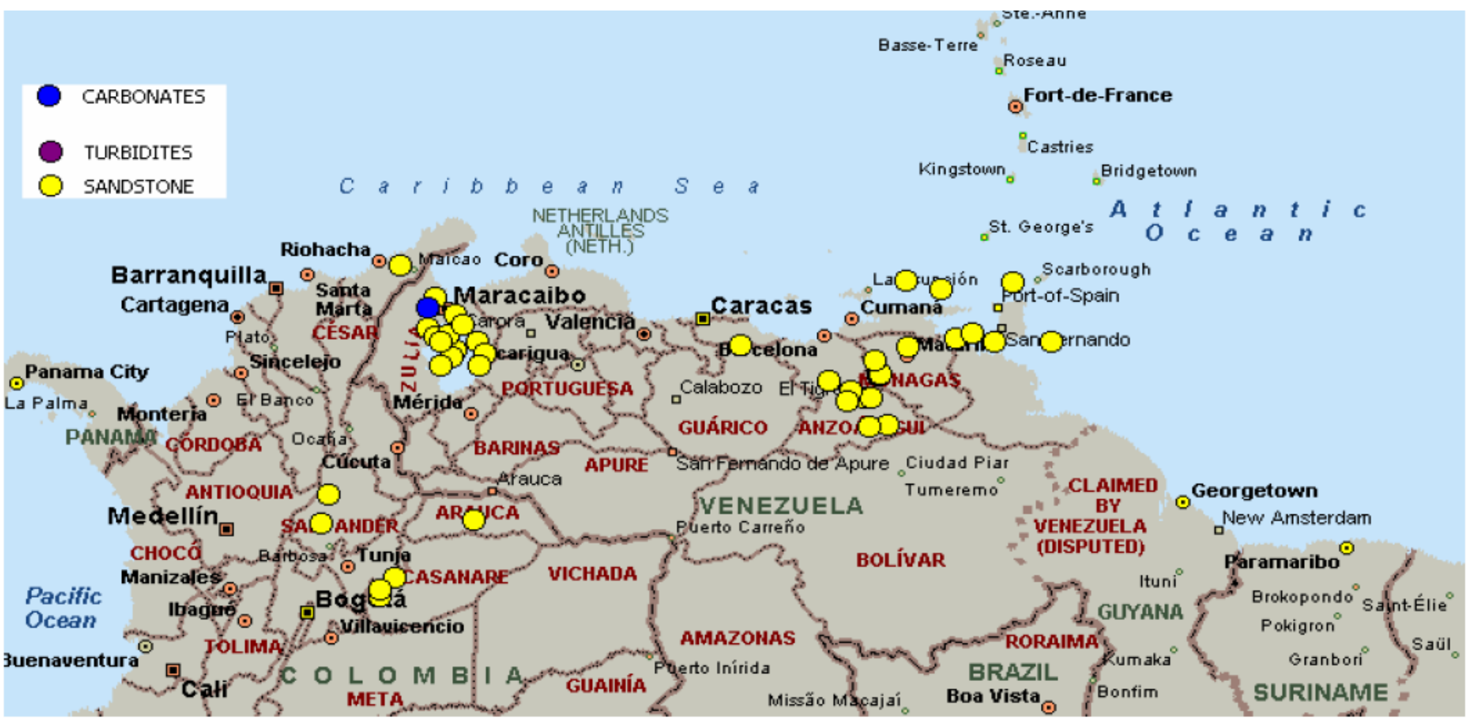

Figure 16. Map of reservoir lithology in giant fields of northern South America.

Example 5: Trap Type

A global map of trap types is shown in Figure 17. As expected, structural traps predominate. In the West Siberia, however (Figure 18), stratigraphic/combination traps are well represented, especially in the southern sector of the West Siberian basin.

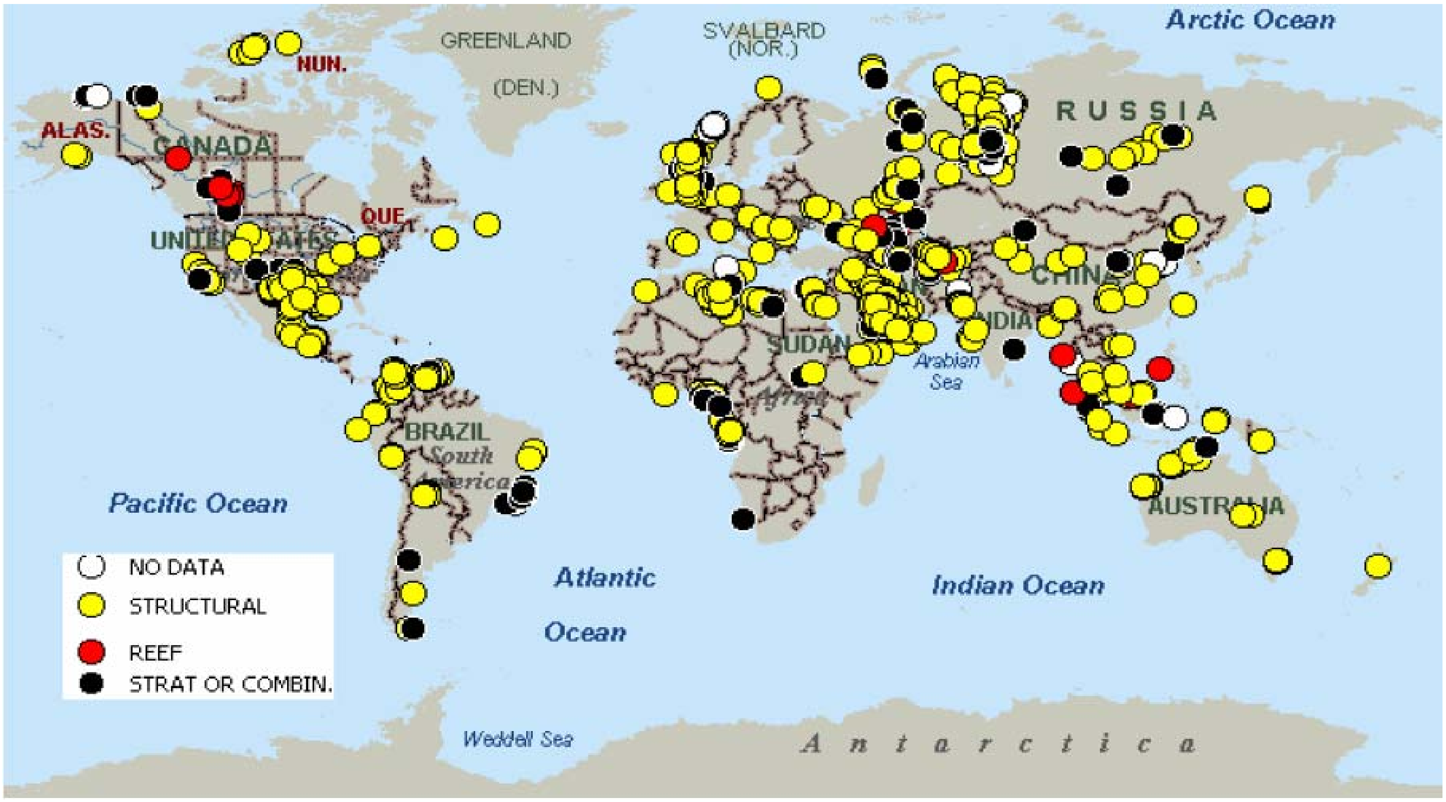

Figure 17. Global map of trap types in giant fields.

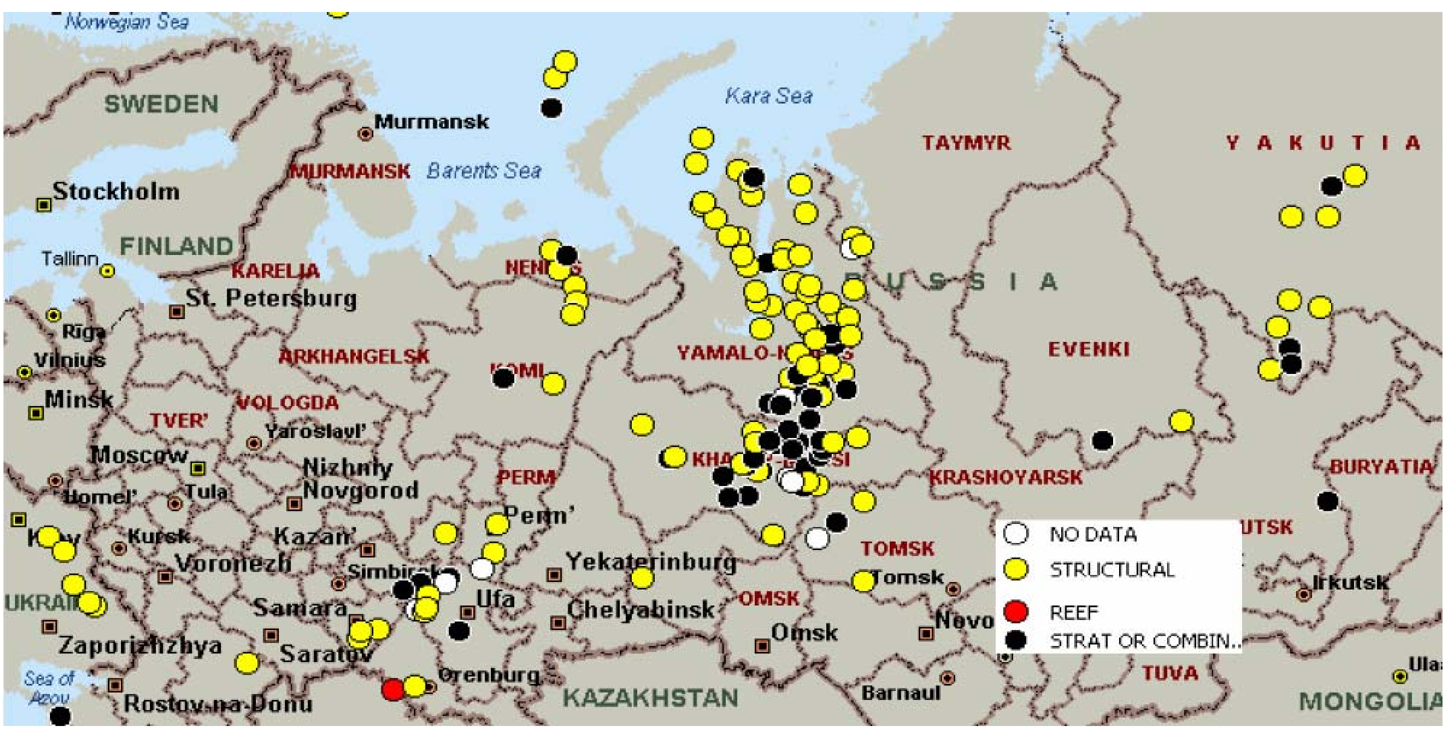

Figure 18. Map of trap types in giant fields of West Siberia.

Example 6: Geologic Age of Reservoirs

Figure 19 is a global map of the geologic age of the reservoirs in the giant fields. As expected, the younger reservoirs tend to be toward the continental margins. Figure 20 is a polar view of the geologic age of giants.

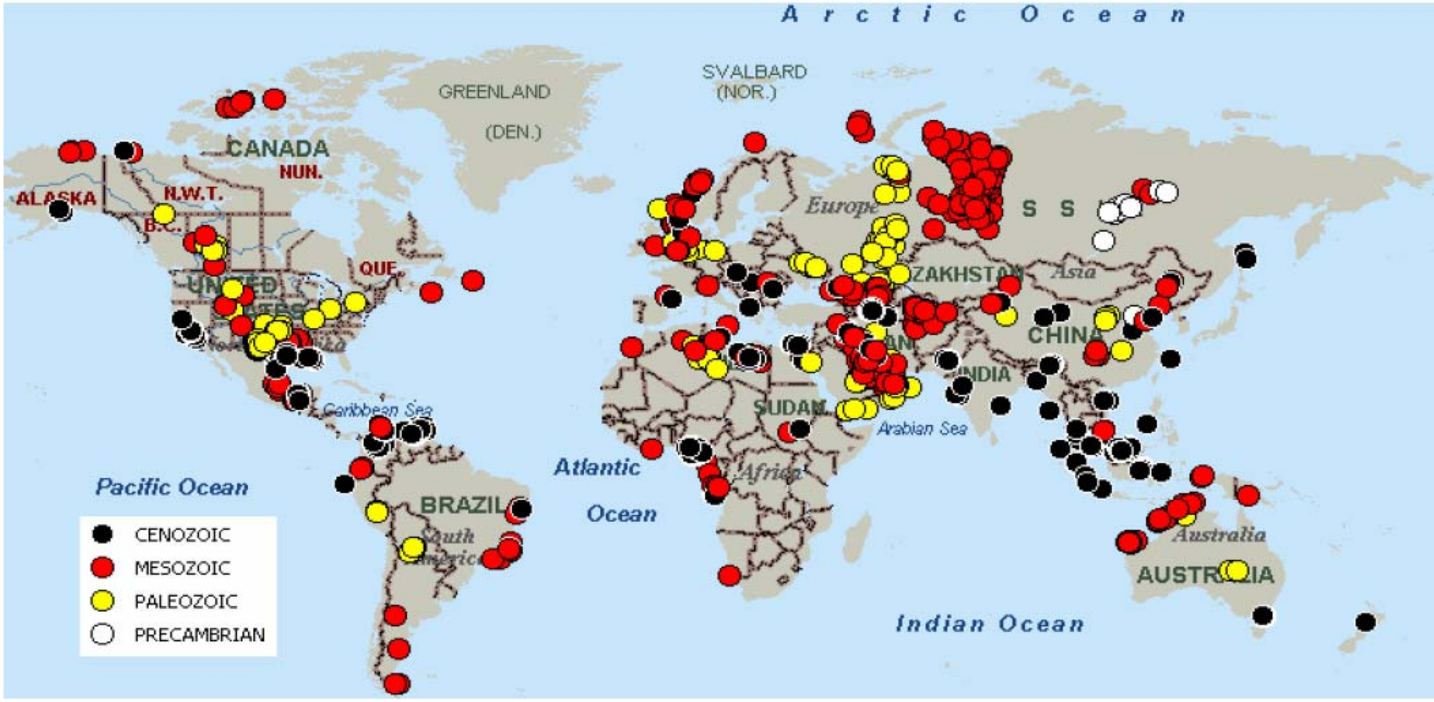

Figure 19. Global map of geologic age of the reservoirs in giant fields.

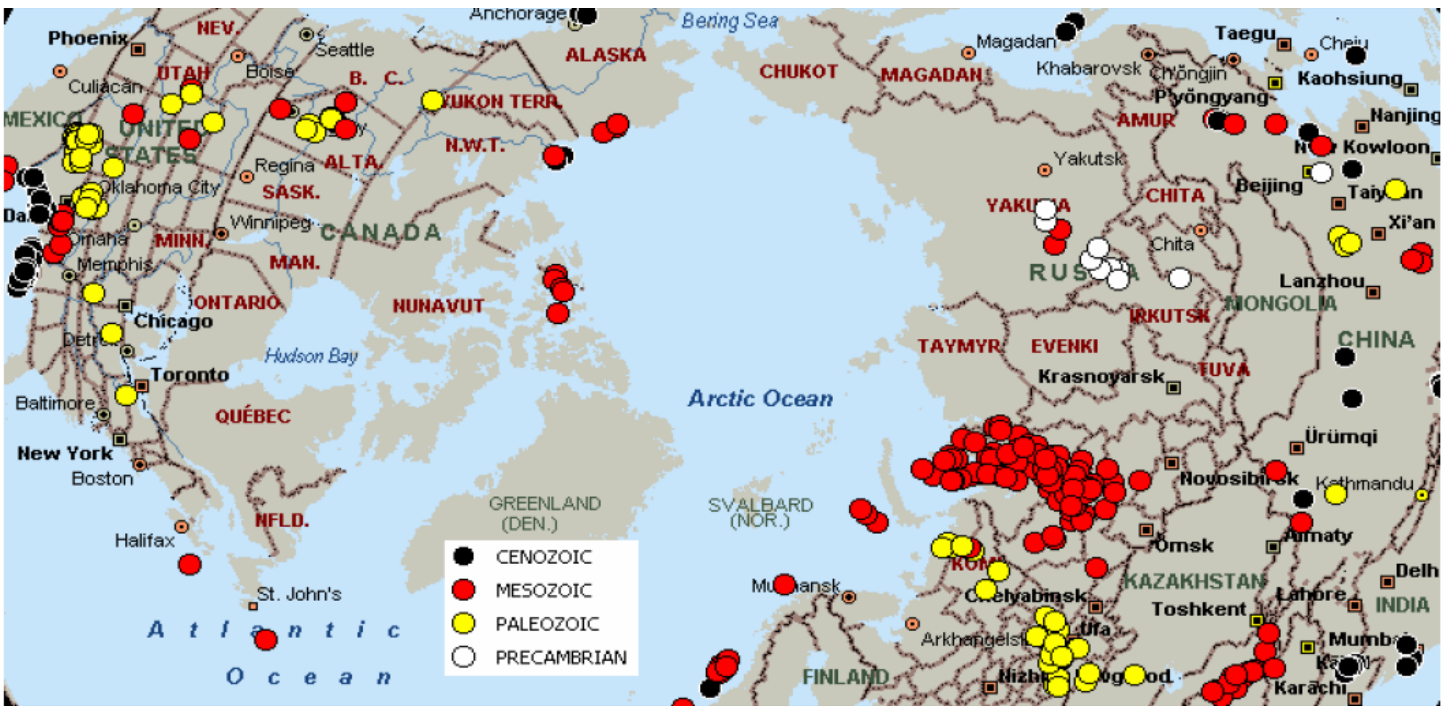

Figure 20. Polar view of the geologic age of the reservoirs in giant fields.

The interval in age, from the youngest (approximately 1 Ma) to the oldest reservoir (600 Ma) in the giant fields, is portrayed in Figure 21. A frequency histogram of the age interval (Figure 22) shows a peak in the number of fields producing from Mesozoic reservoirs.

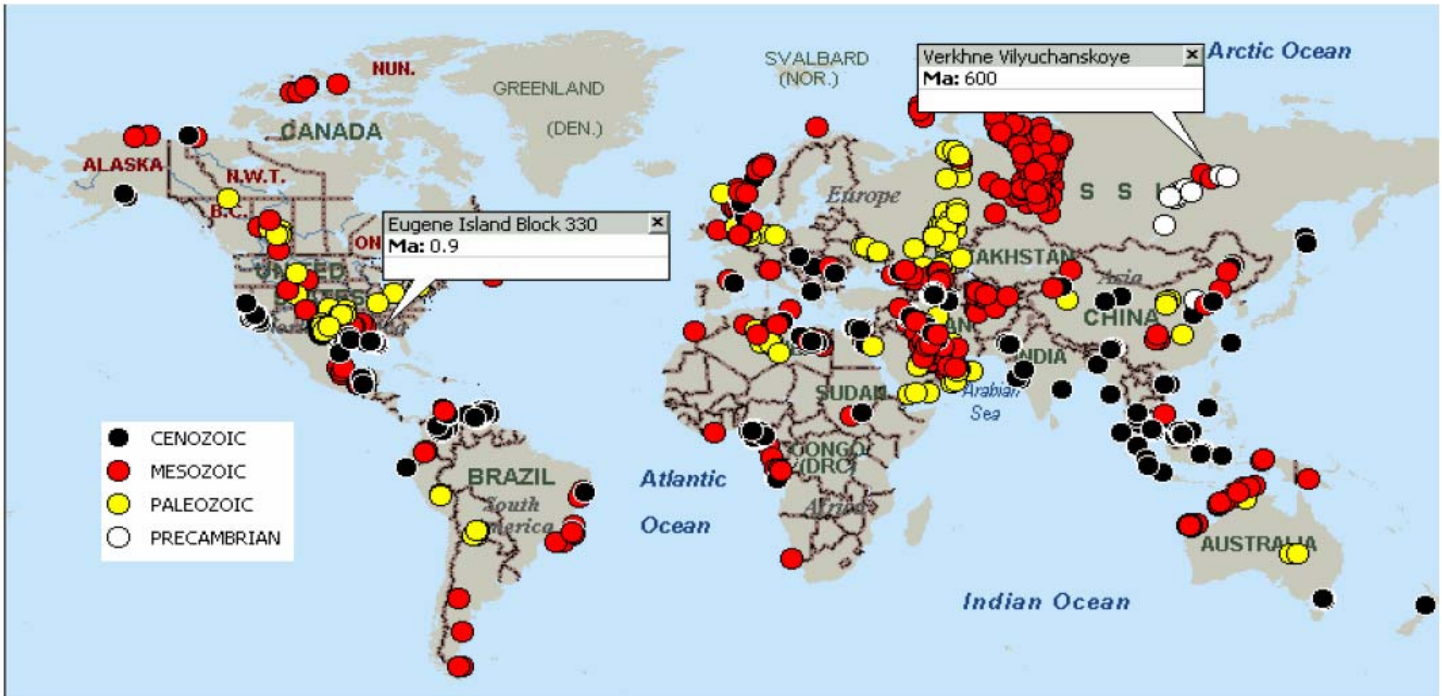

Figure 21. Locations of the youngest and oldest giant fields, in terms of reservoir age, superposed on map of geologic age (Figure 19).

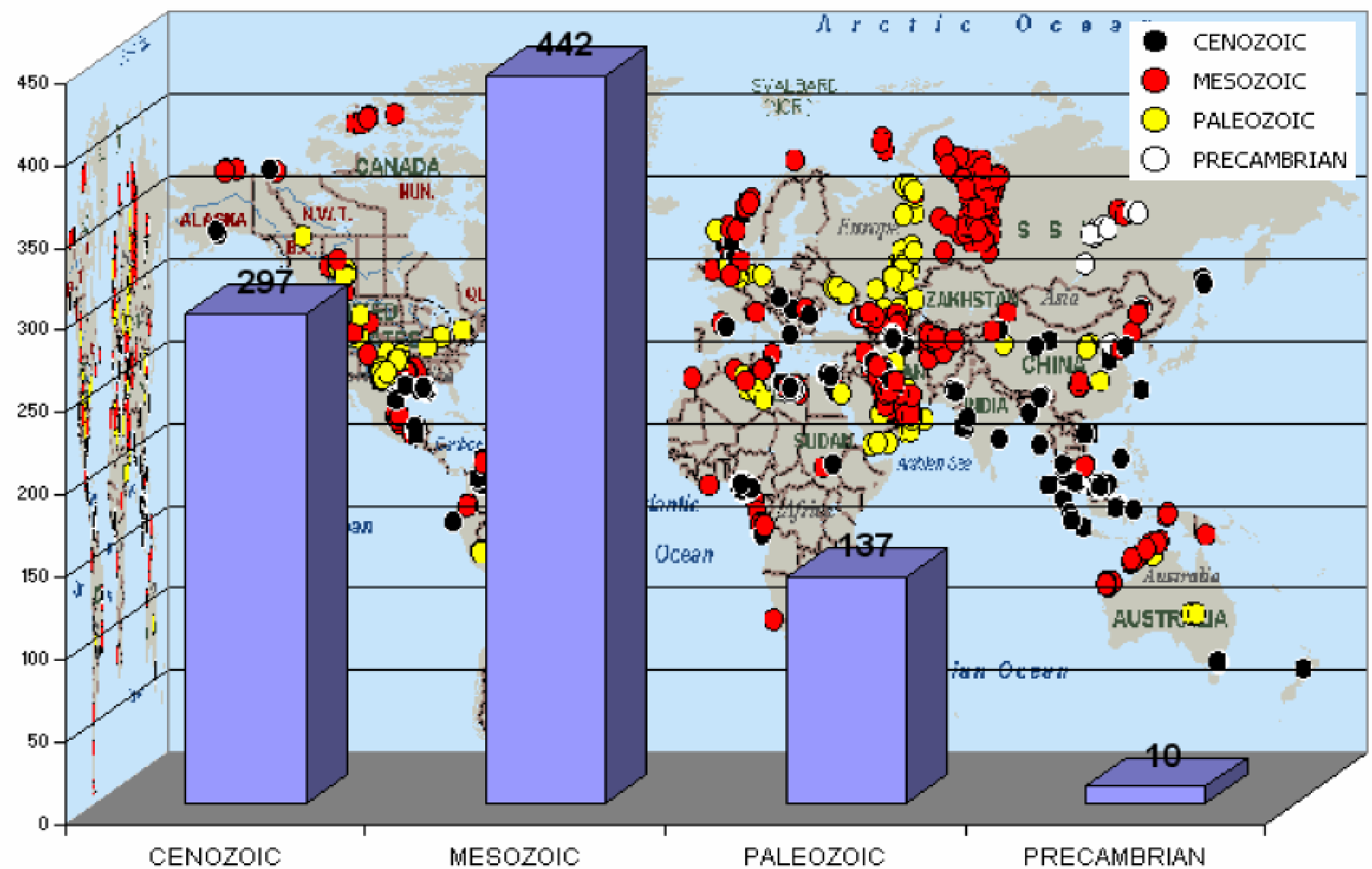

Figure 22. Frequency histogram of the geologic age of the reservoirs in giant fields.

Example 7. Depth of the Primary Producing Reservoirs in Giant Fields

Figure 23 is a map of the depth of the primary producing reservoirs in giant fields. The fields are grouped into deep, intermediate, and shallow. Figure 24 is a polar global view of giant field depths. Figure 25 is frequency histogram of the reservoir depth (in km) of giant fields. The greatest number of fields produces from depths of 1.51-4.49 km.

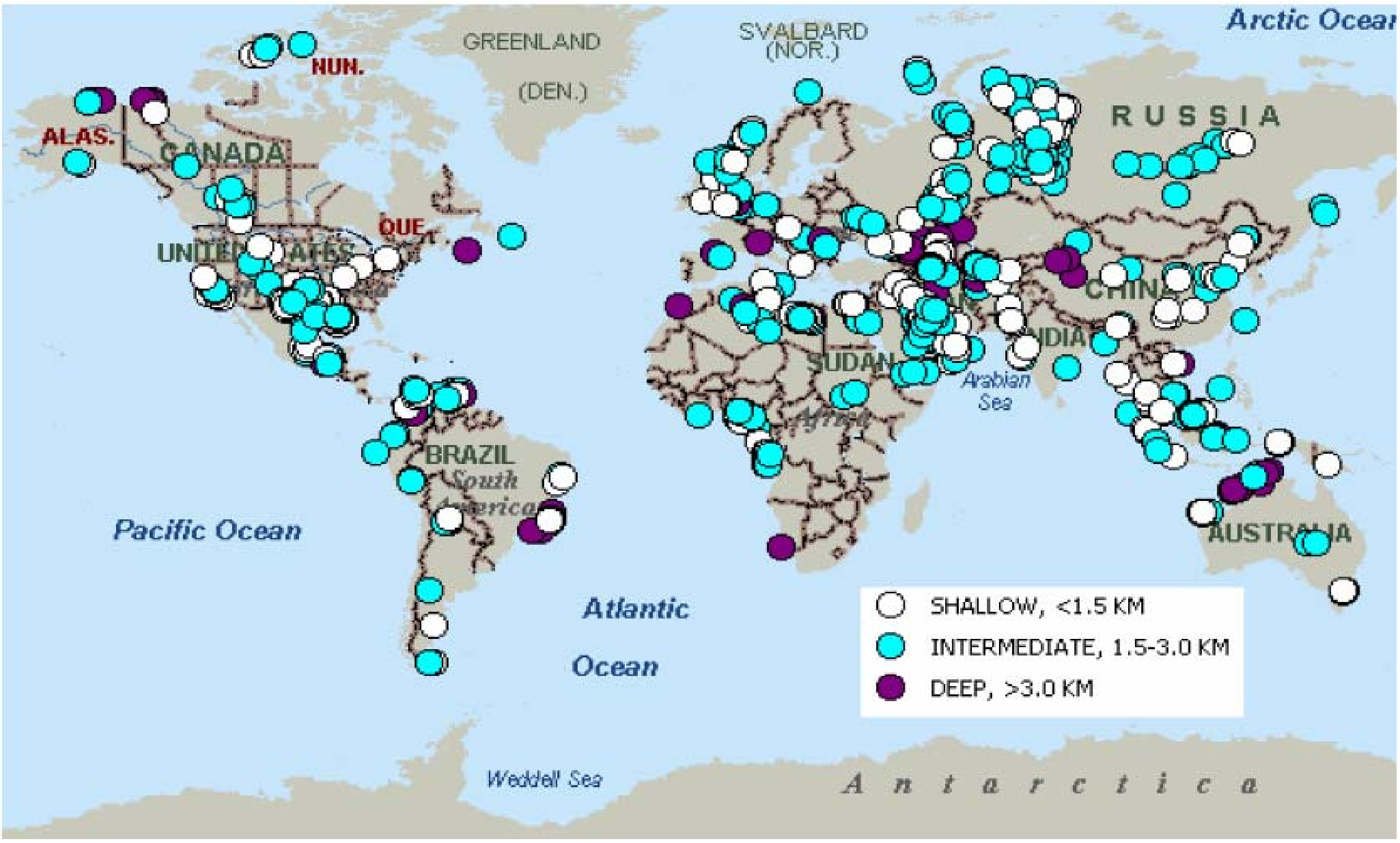

Figure 23. World map of giant fields categorized according to the depths of the primary producing reservoirs.

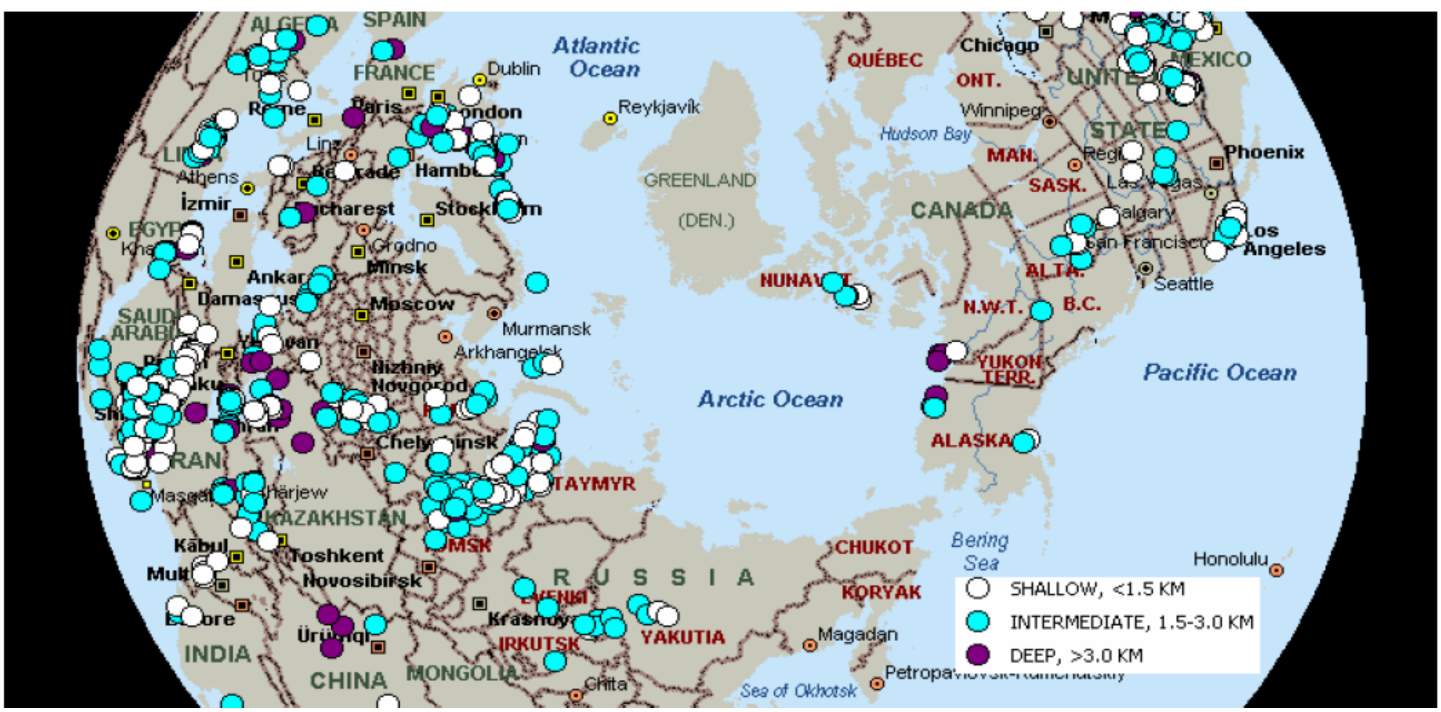

Figure 24. Polar view of reservoir depths of giant fields.

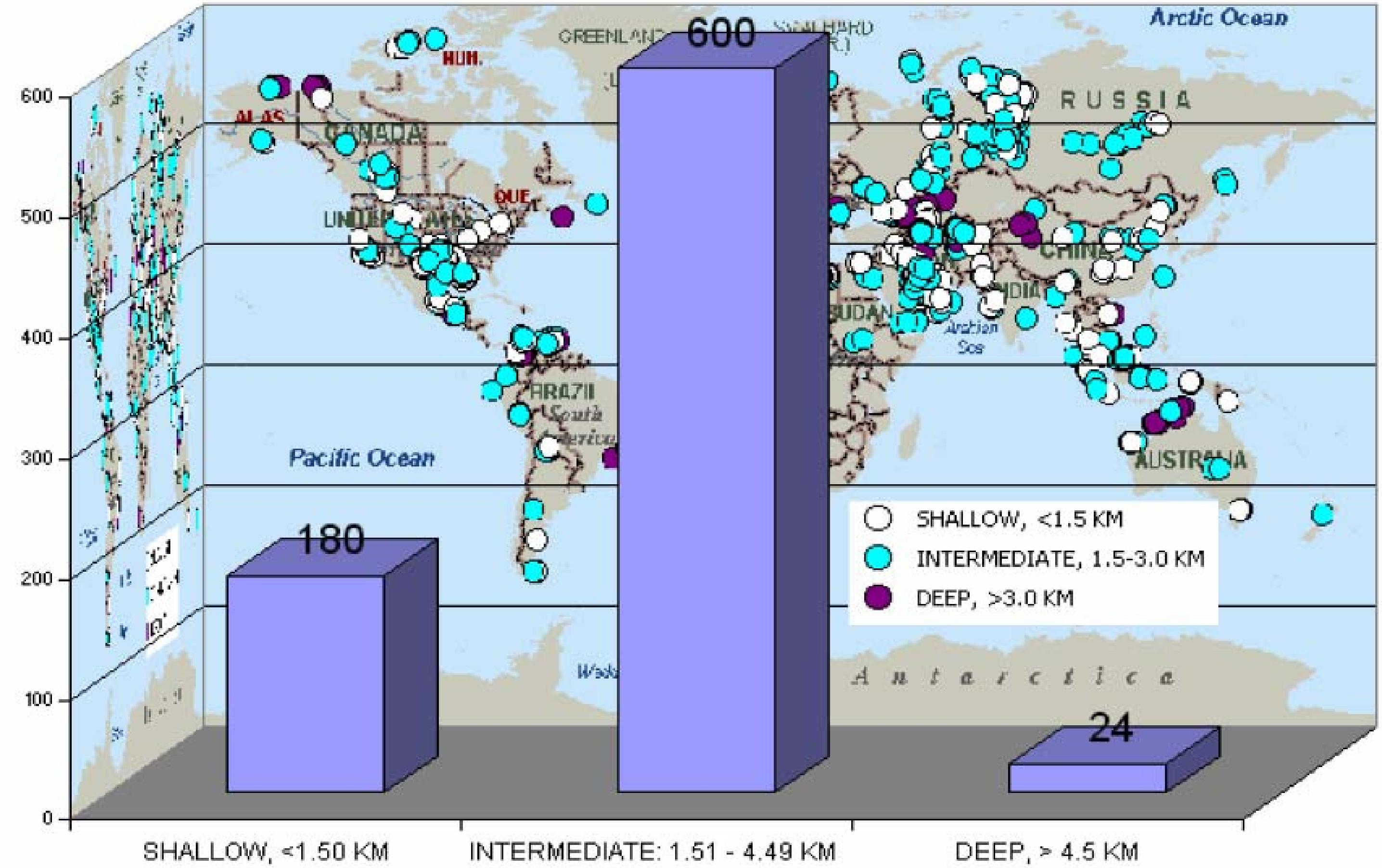

Figure 25. Frequency histogram of reservoir depths of giant fields.

Key References

Horn, M.K., 2003, Giant fields 1868-2003 (CD-ROM), *in* Halbouty, M.K., ed., Giant oil and gas fields of the decade 1990-1999: AAPG Memoir 78, 340p.

Horn, M.K., 2004, Giant fields 1868-2004 (CD-ROM): AAPG/Datapages Miscellaneous Data Series, version 1.2 (revision of Horn, 2003).