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# REPORT OF TEST

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## Comparative $^{13}C$ NMR Spectroscopic Analysis of Prudhoe Bay North Shore Crude Oil and Its Burn Residue

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The burning effects on the chemical composition of Prudhoe Bay crude oil are examined with $^{13}C$ NMR spectroscopy [1] for the Minerals Management Service, Department of Interior. Of specific interest is the fate of the lighter fractions, which include the short-chain alkanes, cycloalkanes, and substituted benzenes.

The principal peaks in the aliphatic region of the crude oil spectrum are assigned in Figure 1 to either chain-ending carbons ($C_1$ through $C_4$) or chain-interior carbons ($C_i$) in alkanes. Their relative intensities reflect the distribution of alkane chain lengths. Upon burning, the $C_1$ through $C_4$ intensities are uniformly attenuated in relationship to the intensity of $C_i$. This result is interpreted as a selective depletion of short chain alkanes in the burned crude. A similar fate is indicated for the cycloalkanes. Their resonances, which are marked with asterisks (Fig 1), are either absent from or attenuated in the spectrum of the burned crude.

Evidence of burning effects is much more dramatic in the aromatic region (Fig. 2) of the crude oil spectra. The sharp signals in Figure 2A, which are due mainly to mono-ring aromatics including benzene, toluene, and xylenes, are for the most part absent in the burned crude spectrum(2B).

A more quantitative examination of the depletion of specific alkanes and cycloalkanes would result from a combination of gravimetric and $^{13}C$ NMR analyses of distillation fractions.

References

1. Kualheim, O.M.; Aksnes, D.W.; Brekke, T.; Eide, M.D.; Sletten, E. Anal. Chem. 57, 2858 (1985).

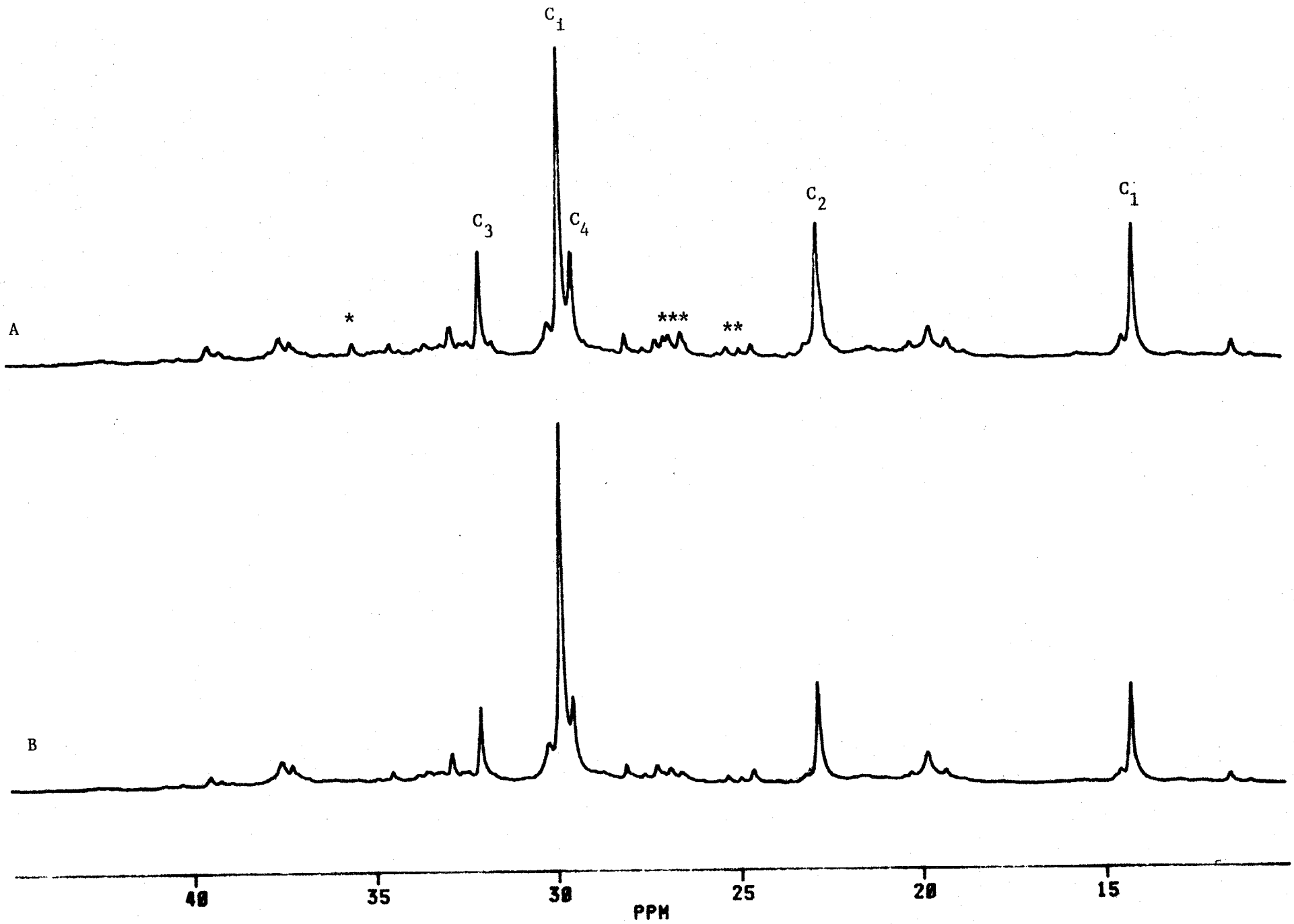


Figure 1. A comparison of the aliphatic region of the $^{13}C$ NMR spectra of (A) Prudhoe Bay North Shore crude oil, and (B) burn residue of Prudhoe Bay North Shore crude oil.

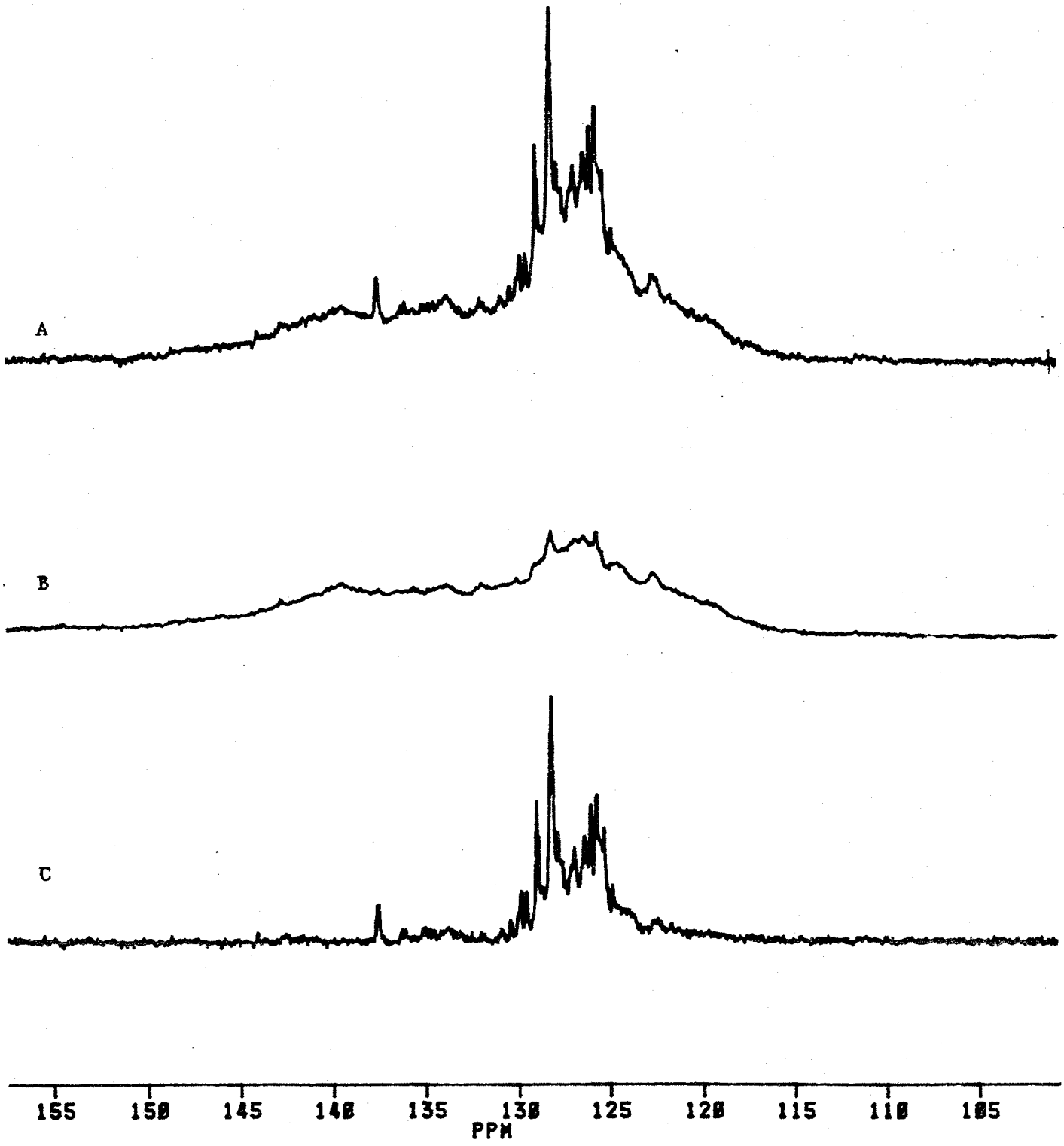


Figure 2. A comparison of the aromatic region of the $^{13}C$ NMR spectra of (A) Prudhoe Bay North Shore crude oil, (B) burn residue of Prudhoe Bay North Shore crude oil, and (C) the difference (A-B). Broad band resonances were normalized to equal intensity.