Oxidation. Oxidation might explain the origin of several features in Tishomingo, including the high-Ni and low-P composition, the presence of SiO$_2$, and the fractionated (Fe/Pd)$_{CI}$ and (W/Ir)$_{CI}$ ratios. A recent study of IVB irons [5] advocated a role for oxidation and further argued that the silicate complement to the oxidized IVB irons might be the oxidized angrites. This is an intriguing suggestion in light of the similarity in $\Delta^{17}O$ between these groups. This oxidation might occur in either the solar nebula or, as suggested by [5], on the parent body.

In their pioneering work, [6] suggested mechanisms for nebular oxidation at a range of temperatures, including reaction of Fe$_2$O with H$_2$S, O$_2$ and H$_2$O. Mechanisms for oxidizing the core on the parent body have not, to our knowledge, been proposed. The fundamental problem is how to deliver a large quantity of oxygen to the core of a body during or after differentiation. Foreign sources (e.g., comets) would have to penetrate (and likely disrupt) the mantle. The most likely scenario would seem to be reaction of metal with water during differentiation. In this vein, the CR chondrites are particularly interesting. With a Ni concentration in metal on the order of 10 wt.% [7], ~70% of the Fe in the metal would need to be oxidized to produce a core with ~32.5 wt.% Ni. The metal in CR chondrites (~15 wt.%) would require ~3 wt.% H$_2$O, assuming a simple stoichiometric reaction of Fe$_2$O+$H_2$O=FeO+$H_2$. This may be realistic, given the hydrated nature of CR chondrite matrix and the high ratio of matrix to metal (~44:7, in vol.%) [7].

We suggest that the most likely precursor for Tishomingo and IVB irons was a volatile-depleted chondrite which contained both metal with moderate Ni concentrations and hydrated matrix. Oxidation by reaction of metal with water occurred during melting, producing one or more parent bodies with small, Ni-rich cores that underwent fractional crystallization. The complex interplay of condensation, oxidation and fractional crystallization produced the Ni-rich irons in our collections.