

# Fe-Mg-O-Zn (Iron-Magnesium-Oxygen-Zinc)

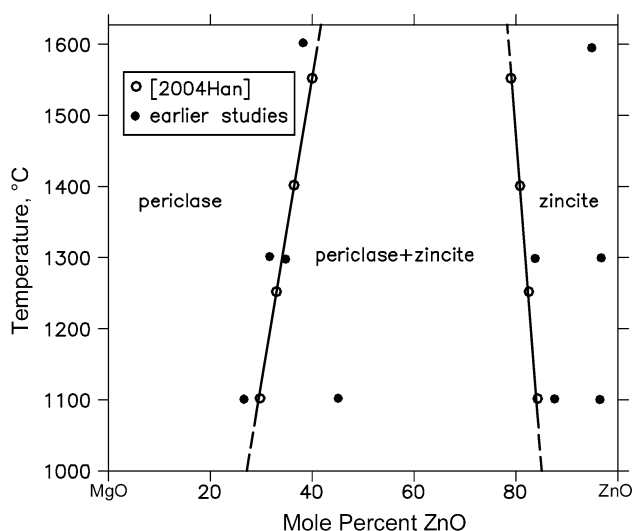
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Control of the slag composition in the zinc smelting process requires knowledge of the solid solutions formed in this quaternary system. Recently, [2004Han] presented three pseudo-ternary sections of this system at 1400, 1250 and 1000 °C based on new experimental data determined in air.

## Ternary Sub-Systems

The phase equilibria with emphasis on the metal-rich region of the Fe-Mg-O and Fe-O-Zn systems were reviewed earlier by [1989Rag1] and [1989Rag2] respectively. Both these systems are updated in this issue from recent reports on the phase equilibria in the oxide region.

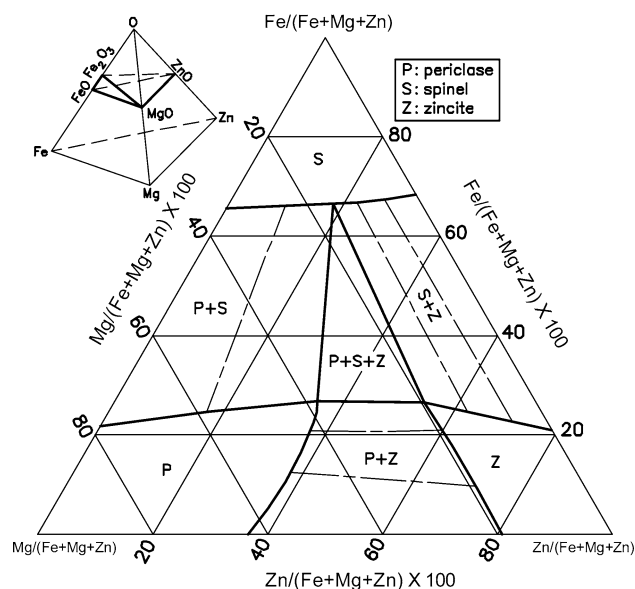
The Mg-O-Zn system was investigated by [2004Han], who also reviewed the previous studies of this system. The pseudo-binary section in air along the MgO-ZnO join in the sub-solidus region determined by them is shown in Fig. 1. The experimental procedures used to obtain the results shown in Fig. 1 are the same as described below for the quaternary system [2004Han]. The solubility of ZnO in periclase (MgO) increases from 30 to 41 mol.%, as the temperature increases from 1100 to 1550 °C. The corresponding increase in the solubility of MgO in zincite (ZnO) is from 16 to 20 mol.%, even though some previous results in this case show a much smaller solubility of ~3 mol.%, see Fig. 1.



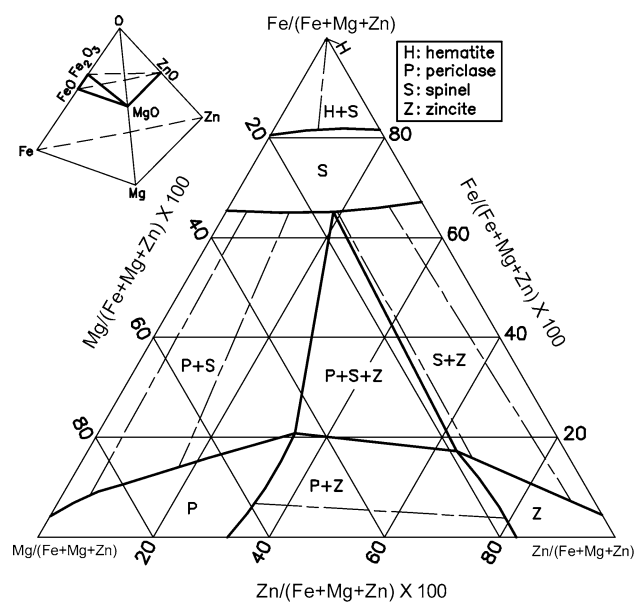
**Fig. 1** Mg-O-Zn pseudo-binary section in air along the MgO-ZnO join [2004Han]

## Quaternary Phase Equilibria

With starting powders of Fe<sub>2</sub>O<sub>3</sub>, MgO and ZnO (99.5+% purity), [2004Han] annealed pellets of powder mixtures in

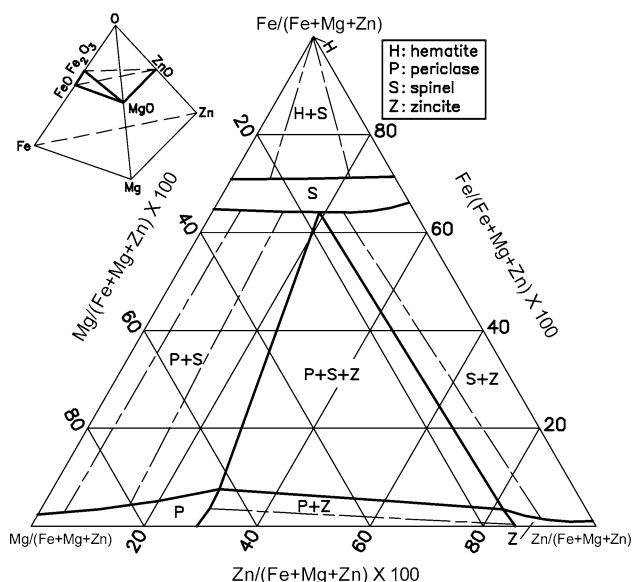


**Fig. 2** Fe-Mg-O-Zn isothermal equilibria in air at 1400 °C projected on to the Fe-Mg-Zn plane [2004Han]



**Fig. 3** Fe-Mg-O-Zn isothermal equilibria in air at 1250 °C projected on to the Fe-Mg-Zn plane [2004Han]

## Section II: Phase Diagram Evaluations



**Fig. 4** Fe-Mg-O-Zn isothermal equilibria in air at 1100 °C projected on to the Fe-Mg-Zn plane [2004Han]

air between 1400 and 1100 °C for 48-168 h, followed by quenching in water. The microstructures were examined with optical and scanning electron microscopy. The

compositions of the coexisting phases were measured by electron probe microanalysis and listed. The isothermal equilibria in air were plotted as projections on the Fe-Mg-Zn plane. Figures 2-4 show these projections at 1400, 1250 and 1100 °C [2004Han]. Hematite ( $\text{Fe}_2\text{O}_3$ ) is stable at 1100 and 1250 °C and dissolves no significant amount of Mg or Zn. The spinels  $\text{MgFe}_2\text{O}_4$  and  $\text{ZnFe}_2\text{O}_4$  form a continuous solid solution. This phase has a range of homogeneity on the Fe-rich side, expanding towards the Fe-rich corner with increasing temperature. Both periclase (MgO) and zincite (ZnO) dissolve an increasing amount of Fe with increasing temperature.

## References

- 1989Rag1:** V. Raghavan, The Fe-Mg-O (Iron-Magnesium-Oxygen) System, *Phase Diagrams of Ternary Iron Alloys. Part 5: Ternary Systems Containing Iron and Oxygen*, Indian Institute of Metals, Calcutta, 1989, p 170-180
- 1989Rag2:** V. Raghavan, The Fe-O-Zn (Iron-Oxygen-Zinc) System, *Phase Diagrams of Ternary Iron Alloys. Part 5: Ternary Systems Containing Iron and Oxygen*, Indian Institute of Metals, Calcutta, 1989, p 370-373
- 2004Han:** R. Hansson, P.C. Hayes, and E. Jak, Phase Equilibria at Sub-Solidus Conditions in the Fe-Mg-Zn-O System in Air, *Scand. J. Metall.*, 2004, **33**, p 355-361