

Influence of Distribution Behavior of Phosphorus Between P-rich and Matrix Phase in CaO-SiO₂-Fe_tO-P₂O₅ Slag

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ABSTRACT

To recycle the phosphorus in P-bearing steelmaking slag, it is necessary to study the distribution of phosphorus between the P-rich and matrix phase. The results show that the adding P₂O₅ into the slag can increase the P₂O₅ content in P-rich phase and have no effect on the phosphorus existence form in the slag. Moreover, the distribution ratio of P₂O₅ between P-rich and matrix phase, the activity coefficient of P₂O₅ and phosphorus capacity in P-rich and matrix phase were calculated, respectively. So P₂O₅ content and slag basicity have an important impact on the distribution of phosphorus between P-rich and matrix phase.

INTRODUCTION

To efficiently recover phosphorus resources from slag to use as fertilizer, it is critical to study the phosphorus distribution between the P-rich and matrix phase in slag. In the paper, the effect of P₂O₅ content and slag basicity on the phosphorus existence form in slag was studied systematically, activity coefficient of P₂O₅ and phosphorus capacity in P-rich and matrix phase were analysed, additionally, the effect of P₂O₅ content on distribution ratio of P₂O₅ between P-rich and matrix phase in slag was discussed, which provide the theoretical foundation for phosphorus enrichment and separation in slag.

METHODS AND MATERIALS

Reagent-grade CaO, SiO₂, Fe₂O₃, P₂O₅ were used to produce experimental slag. The mixed slags (200g) were placed in MgO crucible that were placed inside graphite crucibles and heated in a MoSi₂ electric resistance furnace up to 1773 K. The temperature was maintained for 30 minutes to ensure the slag fully melting. Then, the slags were cooled to 1623 K at 3 K/min and maintained at this temperature for 1 hour to fully promote the precipitation of 3CaO·P₂O₅. Then, the slag samples were cool in the furnace. The phase morphology, composition and mineralogical phases of the slag were observed by SEM, EDS and XRD respectively.

RESULTS

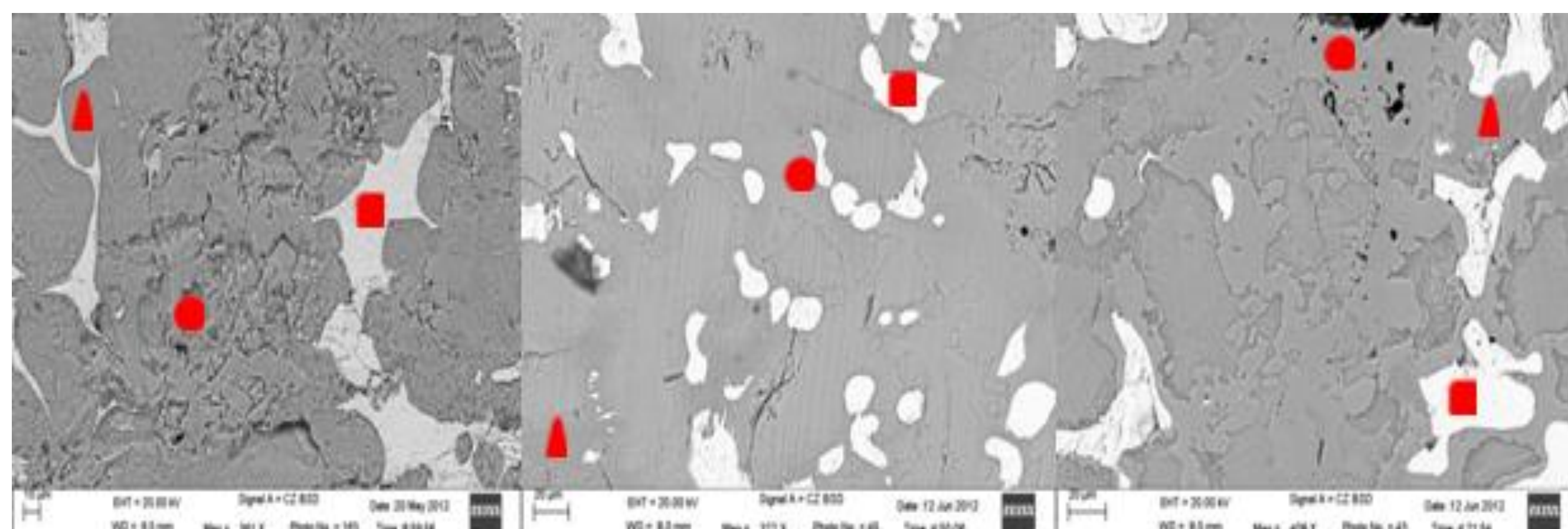


Fig. 1: SEM-BSE image of experimental samples (●-P-rich phase, ■-RO phase, ▲-Base phase)

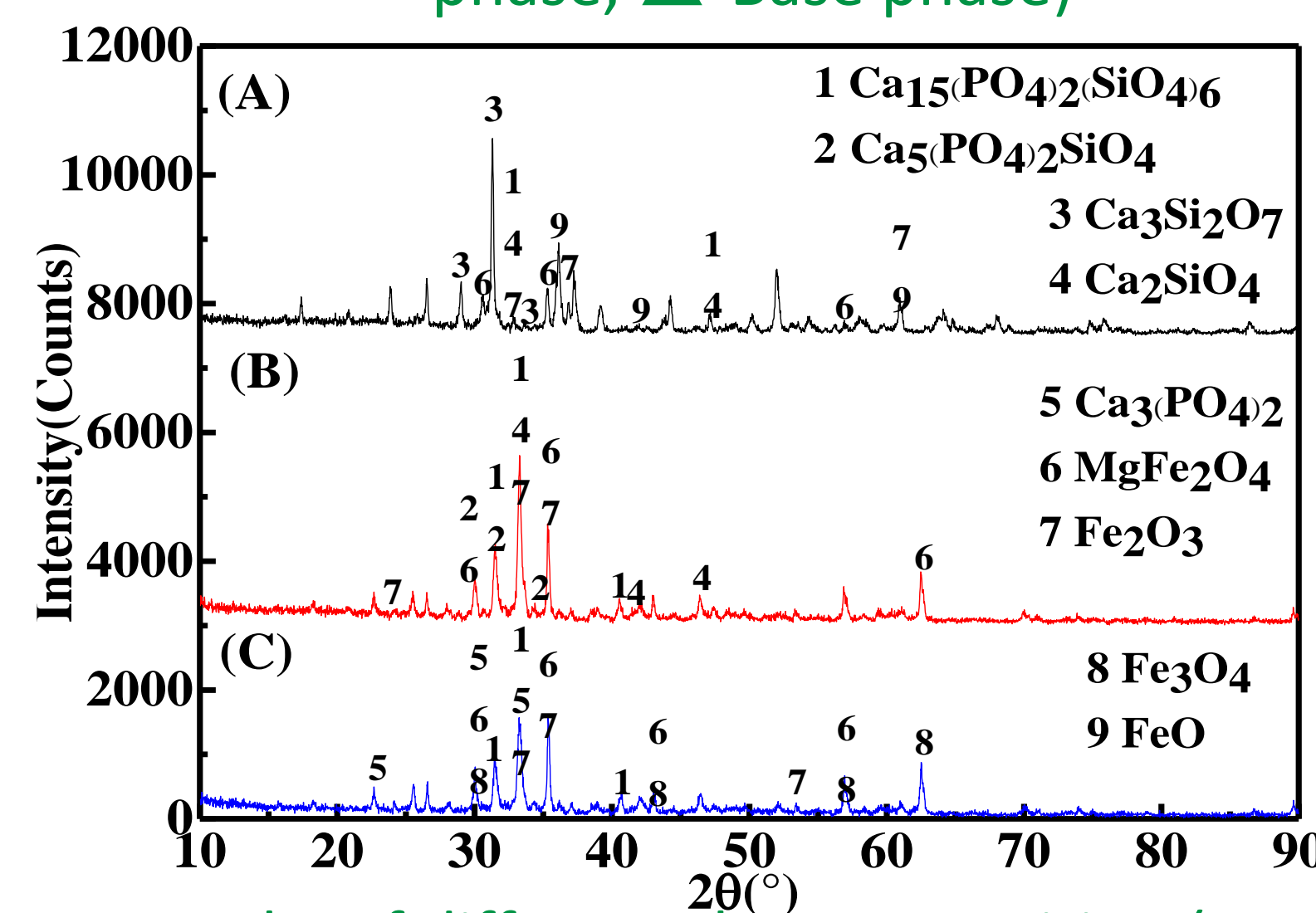


Fig. 1: XRD results of different slag composition (sample A, B and C)

The effect of P₂O₅ on L_p' between P-rich phase and matrix phase and the activity coefficient of P₂O₅

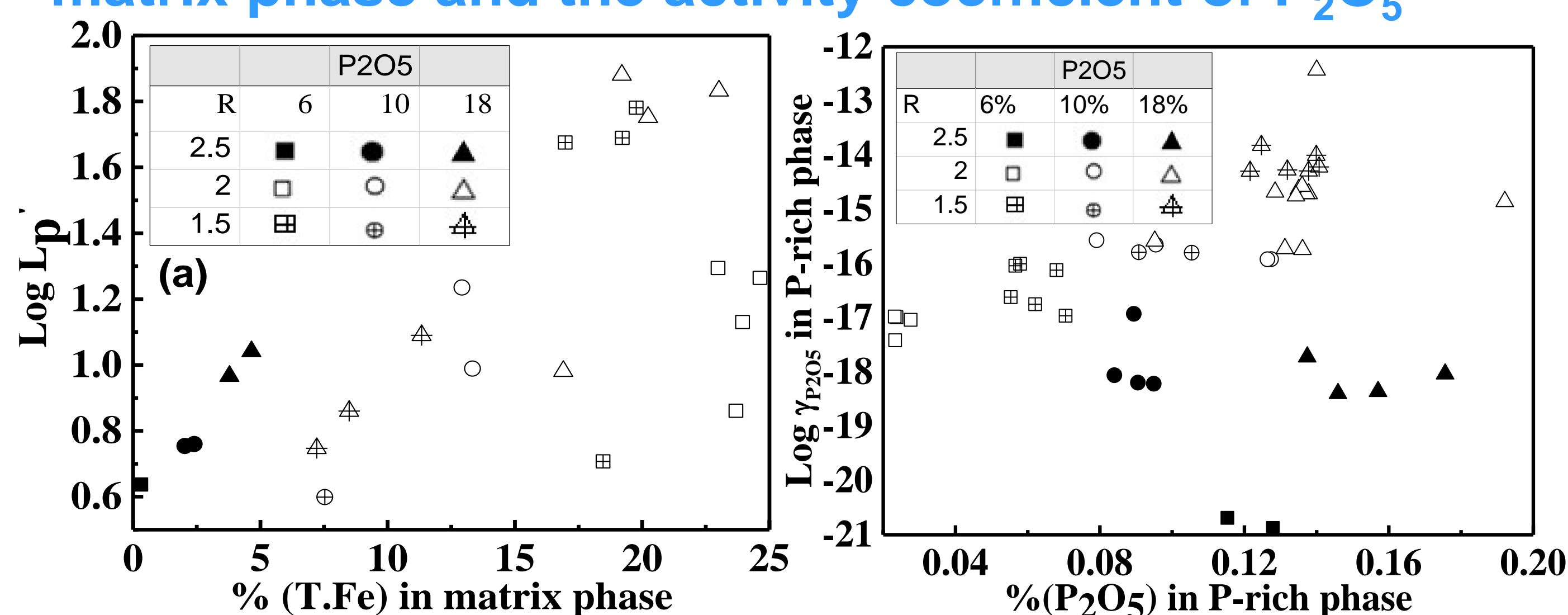


Fig. 1: The effect of % (T.Fe) in matrix phase on L_p' of different slag system

Fig. 1: The effect of % (P₂O₅)_{SS} on the γ_{P2O5(SS)} in different slag systems

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The effect of P₂O₅ on the phosphorus capacity

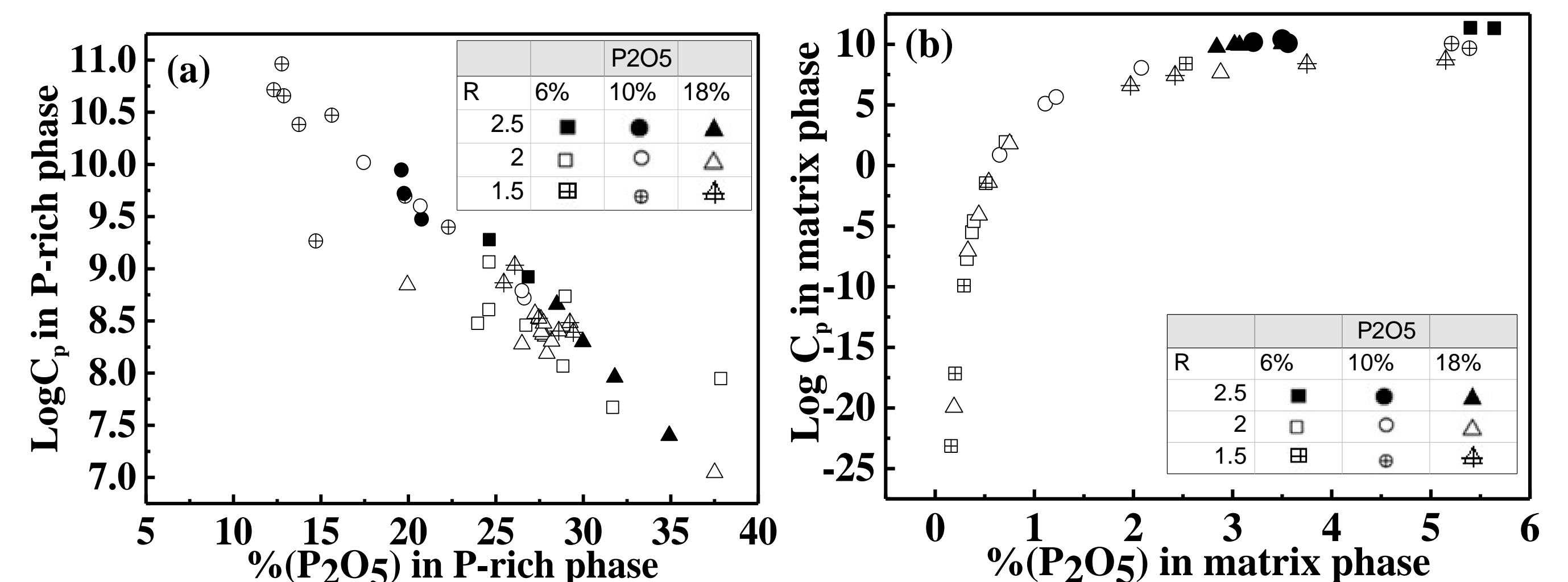


Fig. 1: The effect of % (P₂O₅)_{SS} and % (P₂O₅)_L on log C_p in corresponding phase

CONCLUSIONS

- ✓ The adding of P₂O₅ in the slag can increase the content of phosphorus in P-rich phase and have no effect on the phosphorus existence form in the slag.
- ✓ For CaO-SiO₂-Fe_tO-P₂O₅ slag system, with increase of % (P₂O₅) in slag and decrease of slag basicity, L_p' increases.
- ✓ γ_{P2O5(SS)} increases with increasing % (P₂O₅) in slag and decreasing slag basicity. With increasing % (P₂O₅) in slag, C_{p(SS)} linearly decreases and C_{p(L)} increases.

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