*American Mineralogist, Volume 95, pages 177–184, 2010*

# High *P-T* phase relation of magnesian ($Mg_{0.7}Fe_{0.3}$) staurolite compositon in the system FeO-MgO-$Al_2O_3$-$SiO_2$-$H_2O$: Implications for prograde high-pressure history of ultrahigh-temperature metamorphic rocks

**Kei Sato,[1,*] M. Santosh,[2] and Toshiaki Tsunogae[3,4]**

[1]Department of Earth and Planetary Sciences, Graduate School of Science and Engineering, Tokyo Institute of Technology, 2-12-1 Ookayama, Tokyo 152-8551, Japan
[2]Faculty of Science, Kochi University, Akebono-cho 2-5-1, Kochi 780-8520, Japan
[3]Graduate School of Life and Environmental Sciences, University of Tsukuba, Ibaraki 305-8572, Japan
[4]Department of Geology, University of Johannesburg, Auckland Park 2006, Republic of South Africa

## Abstract

High-pressure and high-temperature phase relation on $Mg_{0.74}Fe_{0.26}$-staurolite composition with excess water in the system FeO-MgO-$Al_2O_3$-$SiO_2$-$H_2O$ was experimentally determined at 12–19 kbar and 850–1050 °C, with a focus on the lower-pressure stability limit of magnesian staurolite. The experimental results show that the stability field of staurolite in the system shifts to higher temperatures as compared to that of pure-Mg staurolite. At 950 °C, the lower-pressure stability limit is located between 15 and 14 kbar. This study demonstrates that staurolite breaks down with isothermal decompression by a series of reactions at 950 °C: St → Opx + Crn + Melt and St + Opx → Spr + Melt. The Mg' [=Mg/(Fe+Mg)] of staurolite in the former reaction is 0.7. When staurolite coexists with orthopyroxene in run products, the staurolite Mg' is decreased to 0.6–0.5. Moderate-Mg staurolite (Mg' = ~0.5) in natural occurrences has been reported as inclusion minerals in poikiloblastic garnets within ultrahigh-temperature (UHT) metamorphic rocks from major collisional orogenic belts in southern India and southern Africa. The experimental data presented in our study suggest the possibility that the staurolite-bearing UHT metamorphic rocks had experienced high-pressure metamorphism and/or UHT extreme metamorphism during the prograde metamorphic stage.

**Keywords:** High *P-T* experiment, magnesian staurolite, ultrahigh-temperature (UHT) metamorphism, Southern Indian Granulite Terrane, Limpopo Belt (southern Africa)