Classifying Chondrules Based on Cathodoluminescence

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BACKGROUND

•Chondrules are melt spherules in the matrix of chondrites.

•Consist of olivine and pyroxene grains, in a mesostasis of feldspar composition

•Original classification schemes involves olivine composition (type I and II, FeO poor and FeO rich olivine) and mineralogy (A, mostly olivine; B, mostly pyroxene; and AB, an intermediate mix of both olivine and pyroxene).

•Sears et al. 1992 proposed a new scheme based on cathodoluminescence (CL). Bright CL = class A, little or no CL = class B, with subdivision into A1-5 and B1-3.

•Expressing the CL classes in terms of mineral and phases composition has proved difficult and Sears (1992) received criticism from Scott et. al (1994) and Grossman and Brearley (2005)

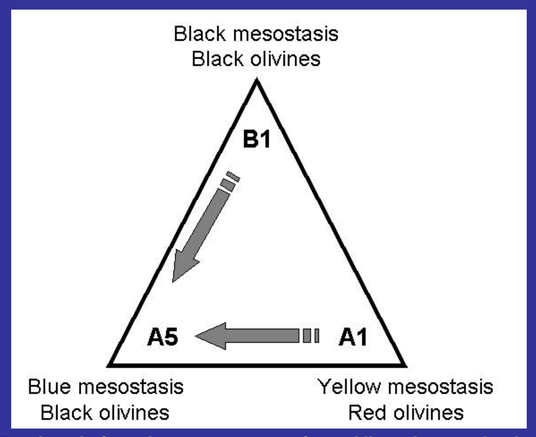

Fig. 1: Cathodoluminescence classification of chondrules. The arrows refer to trajectories caused by metamorphism. The challenge is to express this as mineral compositions.

CATHODOLUMINESCENCE CLASSIFICATION

•Based on CL color/intensity which relate to composition (Figs. 1 and 2).

•Mesostasis and olivine grains analyzed and plotted

OLIVINE DATA

•Plot CaO vs. FeO

•Improved boundaries to be more inclusive

•Boundaries based on data

•Figure 3 shows original and revised plot

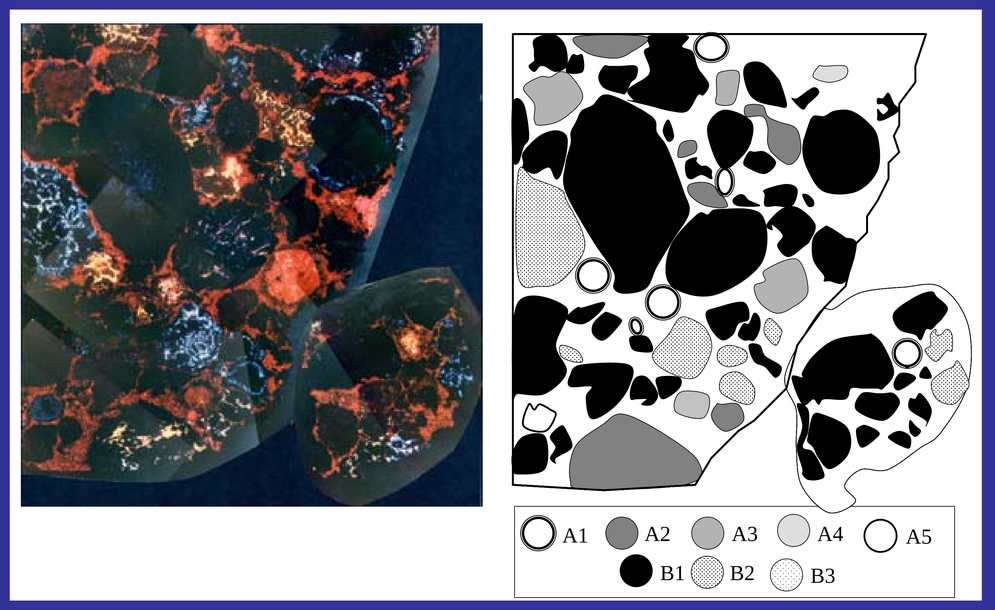

Fig 2. Left: CL image of Semarkona thin section; Right: Sketch of thin section with Sears et. al (1992) classification groups

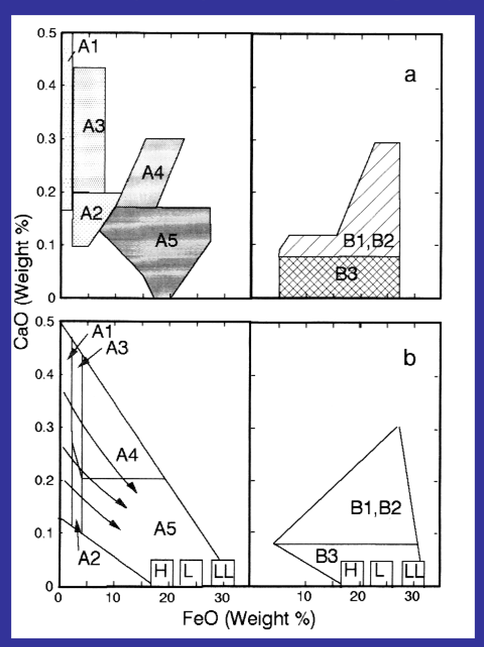

Fig 3: (a) The original olvine plot and (b) the revised plots as published in Sears et al. (1995).

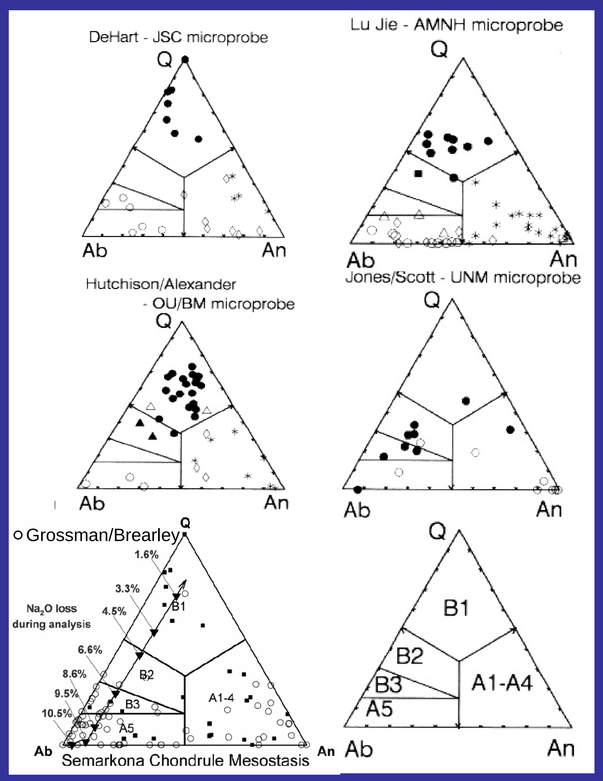

Fig 4: Ternary diagrams of mesostasis data for DeHart (1992) and other authors and the scheme boundaries

MESOSTASIS DATA

•Ternary diagram of quartz, albite and anorthite calculated from wt% oxides using CIPW norm

•Grossman/Brearley (2005) claim DeHart (1992) Na values low because of vaporization during analysis

•Lu Jie (1990), Hutchison/Alexander (1995) and DeHart (1992) have similar data disbursement

•Analytical conditions similar for all authors

DISCUSSION

•If the DeHart (1992) data are deficient in sodium, then a solution would be to lower the boundaries

•However, it is also possible that the Grossman/ Brearley (2005) data are not representative of the CL classes.

CONCLUSIONS

•**C**urrent data are not adequate to change the boundaries of the mesostasis ternary diagram, nor claim that the current boundaries are correct.

•I suggest that probe conditions should be identified in which Na loss is known not to be occurring and CL classified chondrules should be analyzed.

REFERENCES

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