OCCURENCE OF POST STISHOVITE IN SHERGOTTITES NWA 856 AND ZAGAMI: A CATHODOLUMINESCENCE STUDY. H. Chennaoui Aoudjehane[1-2], A. Jambon[2], [1]Université Hassan II Aïn Chock, Faculté des Sciences, Equipe Géoressources, BP 5366 Maârif Casablanca Morocco (e-mail: chennaoui_h@yahoo.fr), [2]Université Pierre et Marie Curie-Paris6 Laboratoire MAGIE, Case 110, 4 place Jussieu, 75252 Paris France (e-mail: jambon@ccr.jussieu.fr)

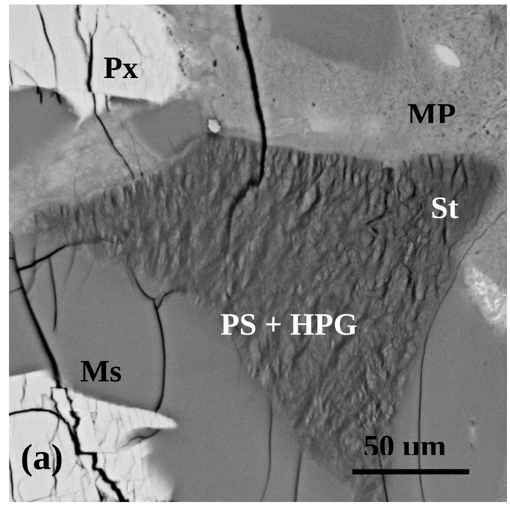
The physical state of silica is a very useful index of shock in meteorites. Its study has been revived by the discovery of high pressure silica in Shergotty of the αPbO_2 and ZrO_2 structure [1- 4]. Shergottites usually contain a few percent of silica with varied textures depending on their location in the rock.

Cathodoluminescence (CL) imaging and spectroscopy is a powerful technique which enables easy identification of tridymite, cristobalite, quartz, coesite, stishovite and high/low pressure silica glass. This was cross checked previously by Raman spectroscopy on reference samples and shergottites [5]. According to its textural signature we suspected the presence of post stishovite as described previously [1, 2], but we were unable to collect unambiguous CL spectra with the additional difficulty that Raman spectroscopy is destructive to this phase.

The strong luminescence of stishovite enables easy collection of its CL spectra. In addition, imaging at the maximum wavelength of stishovite permits to locate this phase rapidly and efficiently even when small grains are present and throughout a polished section. The luminescence of high pressure silica glass is weaker but the large number of areas with pure HP silica glass and their significant size permitted to record its spectrum without difficulty.

The problem with post stishovite is of another kind. The only way to recognize post stishovite was from its textural aspect; Raman spectroscopy must be avoided and all grains for which electron or X-ray diffraction patterns had been obtained were all extracted previously from the sections. After a systematic survey of the putative grains we could distinguish between stishovite, HP glass and spectra differing from all the silica phases studied so far. Such CL spectra are weaker than those of either HP glass or stishovite. It also appears that post stishovite does never occur alone, but always mixed with HP glass or Stishovite blurring its specific luminescence. Using this procedure, we could detect the presence of post stishovite in two shergottites NWA 856 and Zagami where it was not recognized previously.

Images of a pure silica grain in NWA 856 are shown below, with the characteristic texture of post stishovite (Fig 1). It illustrates the difficulty of separating stishovite, post stishovite and HP silica glass. The grain seems quite homogenous. Its CL image shows that part of the grain is stishovite; the remainder being a mixture of post stishovite and HP silica glass. In Zagami, we present an image of a silica grain with stishovite and the tweed pattern [2] characteristics of post stishovite associated with HP



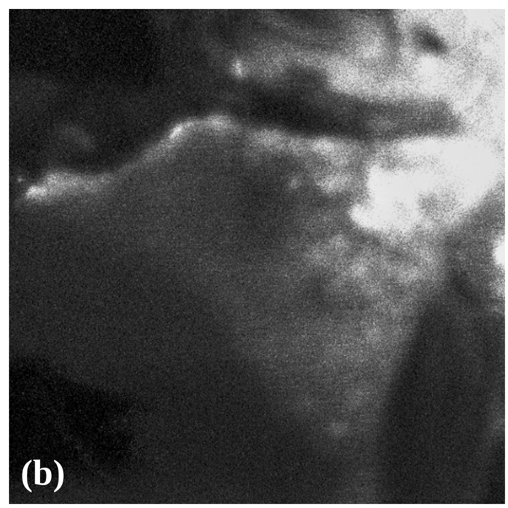
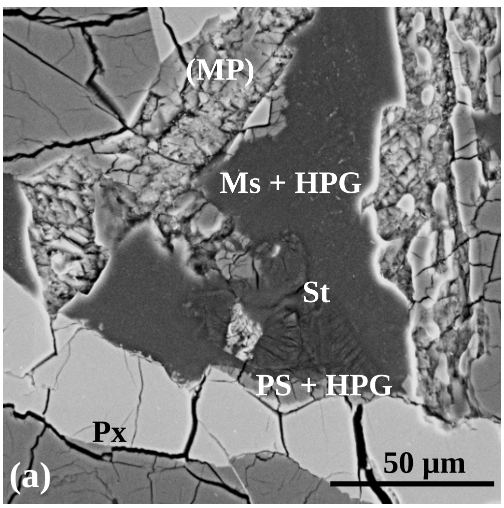


Figure 1: BSE (a) and CL (b) image of a grain of silica in NWA 856 with the characteristic form of post Stishovite (PS), surrounding by maskelynite (Ms) and a melt pocket (MP). The CL image shows the high luminescence of Stishovite area in the top of the grain and the melt pocket. The low luminescent part of the grain is a mixture of HP silica glass (HPG) and post Stishovite.

silica glass (Fig 2). The distinction between stishovite and post stishovite or HP silica glass is not possible from a BSE image alone.

A series of spectra in the three silica phases in NWA 856 and Zagami (Fig 3, 4, 5) permits to visualize the strong differences between the spectra. For post stishovite, there are three major peaks near 15,500, 19,500 and 21,000 cm^{-1}. For stishovite, there are three peaks near 11,500, 22,500 and 25,200 cm^{-1}. For the HP silica glass, there are two peaks near 15,100 cm^{-1} and 18,500 cm^{-1}.



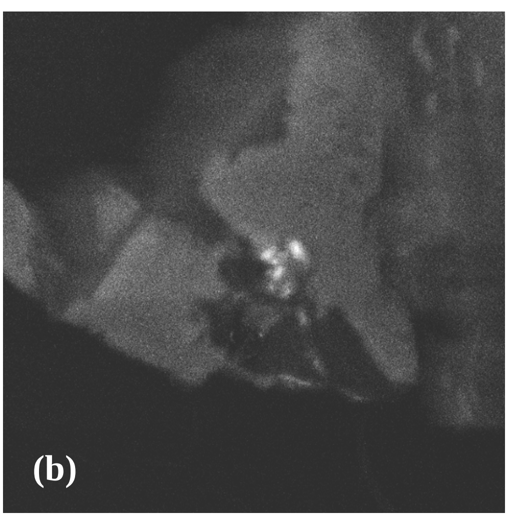


Figure 2: BSE (a) and CL (b) image of a grain of silica in Zagami. The mixture of Maskelynite (Ms) and high pressure silica glass (HPG) have a higher luminescence than the mixture Post Stishovite (PS) high pressure silica glass and than the special melt pocket (MP).

Figure 3: Post stishovite CL spectra in zagami and NWA 856

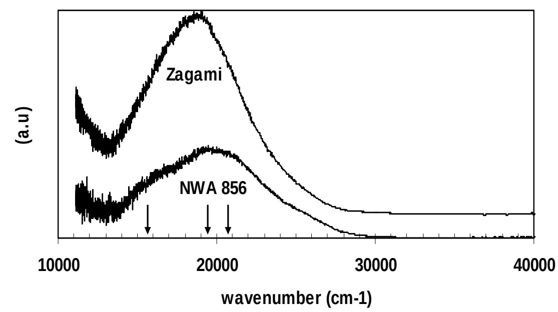


Figure 4: Stishovite CL spectra in zagami and NWA 856

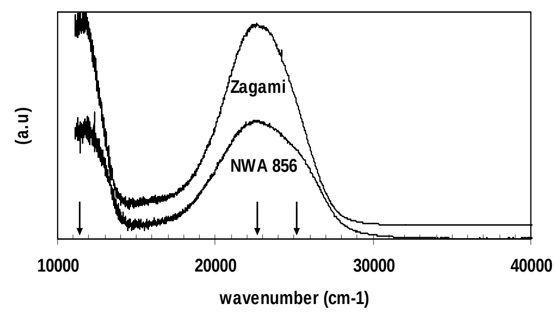
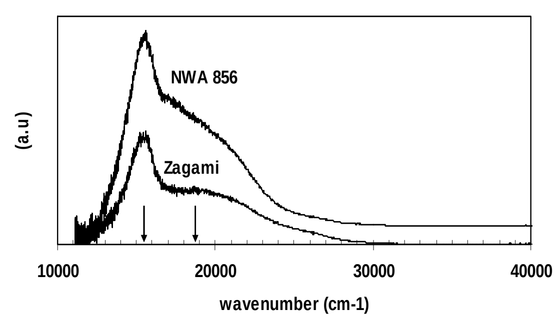


Figure 5: HP silica glass CL spectra in zagami and NWA 856



CL appears an easy and powerful technique for identifying silica and particularly post stishovite in shocked meteorites. Unlike Raman spectroscopy it remains harmless to the samples. It is far more practicable than X-ray or electron diffraction patterns. The presence of post stishovite in all shergottites investigated so far is a strong argument to suggest a shock intensity of at least 40 GPa.

References: [1] Sharp T.G. et al (1999) Science 284, 1511-1513. [2] El Goresy A. et al. (2000) Science **288**, 632-634. [3] Malavergne V. et al. (2001) MAPS **36**, 1297-1305. [4] El Goresy A. et al. (2004) Jour. Phys. Chem. Sol. **65**, 1597-1608. [5] Chennaoui Aoudjehane H. et al. (2005) MAPS **40**, 967-979.