INITIAL SEARCH FOR EVIDENCE OF IMPACT, LAKE EJAGHAM, CAMEROON. D. T. King, Jr.[1], L. W. Petruny[1], and J. C. Stager[2]. [1]Geosciences, Auburn University, Auburn, AL 36849 USA [kingdat @ auburn.edu]. [2]Natural Sciences, Paul Smith’s College, Paul Smiths, NY 12970 USA.

Introduction: Lake Ejagham is a small, shallow lake in the southwestern part of Cameroon (western Africa; 5^o 45’ N; 8^o 59’ E). This part of Cameroon includes the Mamfe basin, a basin comprised of Cretaceous clastic formations [1, 2], which are covered in part by basaltic flows [2]. Basalts are associated with maar structures in the area, which contain numerous circular lakes [3, 4]. In contrast to the other lakes of the Mamfe basin, Lake Ejagham is oval-shaped and relatively very shallow (< 20 m), which is not consistent with the phreatic explosion (maar) model as has been previously suggested for most circular lakes in the area [4]. Further, Lake Ejagham is situated in Cretaceous clastics, not in the basaltic terrain where maar lakes are found [4]. Figure 1 shows Lake Ejagham and its surroundings. This lake is elliptical (about 1000 m long and about 600 m wide) and it has a low rim of few m height. Lake sediments have been dated at a few thousand years [5]. Suggestions that Lake Ejagham may have formed by meteoritic impact have been offered by the scientist who cored the lake (as noted by 5]) and by [6] who lived there and has visited the site.

Figure 1. Lake Ejagham, Cameroon. From Google Earth©.

Methods: In this study, selected cored sediment samples from near the center of the lake were studied in an initial search for any mineralogical evidence of impact effects. Two lake core samples, which were provided by one of the authors (JCS), were placed in small plastic containers (1.5 cm in diameter), which were then filled with blue epoxy. A petrographic thin-section was made along two horizontal slices through each of the four containers bearing lake sediments, and two 30-µm petrographic thin sections were made from each slice.

Results: Under binocular an petrographic microscopic examination, the samples studied are characterized by abundant grey-brown, clay-bearing detrital grains embedded in a grey-brown clay matrix (Fig. 1). The ratio of clay to detrital grains is approximately 50:50. The matrix is very dark amber to nearly opaque in thin section and contains about 30% finely macerated organic material, including some woody fragments, but the matrix mainly consists of small, opaque masses about 10-15 µm in diameter. The matrix is almost entirely free of mica flakes. Detrital grains consist almost entirely of quartz and feldspar. The average detrital grain size is about 0.5 mm, which is the medium/coarse sand boundary. The quartz grains are generally larger than the feldspars. There is a distinct bimodal size distribution among the detrital grains larger than 0.004 mm diameter (Fig. 2). By volume, about 65% of the detrital grains were in the size range of 1 to 4 mm (very coarse sand to granule size), and the remainder were fine sand and silt (0.25 to 0.004 mm). The larger detrital grains commonly possessed a slight frosting or polishing on their surfaces, suggestive of chemical weathering and/or aeolian activity prior to inclusion in the lake deposits.

Some of the quartz grains display undulose extinction across the whole grain or in domains within the quartz grain. Some quartz grains display possible evidence of toasting, which is not definitive evidence of shock metamorphism in the absence of other idications such as planar deformation structures (PDFs). The only other internal structure in the Lake Ejagham quartz noted in our study are planar fractures, lines of bubbles, and minute rutile inclusions. Definitive evidence of shock metamorphism was lacking in these samples among the quartz and feldspar grains, and no melt spherules or glass fragments were identified either.

Discussion: Regarding possible evidence of toasting, rare coarse quartz grains from Lake Ejagham exhibit what *may be* a type of toasting along discolored, curviplanar fractures that are laden heavily with small fluid inclusions (Figs. 3 and 4).

Toasting in quartz, which is thought to be a either a post-impact hydrothermal effect [7], a water-exsolution effect [8], or an effect of vessiculation upon impact-pressure release [9], can be diagnostic for impact, but is not considered strong evidence of impact unless accompanied by other diagnostic petrographic evidence, which is lacking in our study. For example, pervasive toasting was found in abundance within some quartz grains extracted by drilling at Pleistocene Lake Bosumtwi impact structure in adjacent Ghana [9]. At Bosumtwi, in contrast to Lake Ejagham, there is also ample evidence of impact effects (e.g., quartz with planar deformation features and silicate melt grains).

Toasting most commonly affects the whole quartz grain or affects large areas of the affected quartz grain, so it is peculiar here that the possible toasting, if that is what this discoloration represents, affects only the area immediately adjacent to (i.e., within a few microns) of the fluid-inclusion laden curviplanar fractures (Fig. 4).

Conclusions: Even though the elliptical shape and relatively shallow depth of Lake Ejagham is out of character for the terrain where it lies, so far no diagnostic mineralogical evidence of impact in Lake Ejagham's sediments has been found. Possible toasting along curvi-planar fractures in rare quartz grains remains an enigmatic feature of these lake sediments. Additional samples will be examined in the future to help resolve questions about the origin of this lake.

References: [1] Fairhead J. D. et al. (1991) *Tectonophysics 186*, 351-358. [2] Ndougsa-Mbarga T. et al. (2007) *Geofisica Internacional 46*, 129-139. [3] Tokam A.-P.K. (2010) *Geophys. J. Int'l.* [4] Kling G. (1987) *Comparative limnology of lakes in Cameroon, West Africa*, Ph.D. dissertation, Duke Univ. [5] Stager J. C. et al. *Quaternary Geology* (in press). [6] Burress B. (2015) ww2.kqed.org. [7] Short N. M. and Gold D. P. (1996) *Geol. Soc. Amer. Spec Paper 302*, 245-265. [8] Ferrière L. et al. (2009) *LPSC XL*, abst. # 1751. [9] Whitehead J. et al. (2002) *Geology 39*, 431-434. [10] Morrow J. R. (2007) *Meteoritics and Planet. Sci. 42*, 51-609.

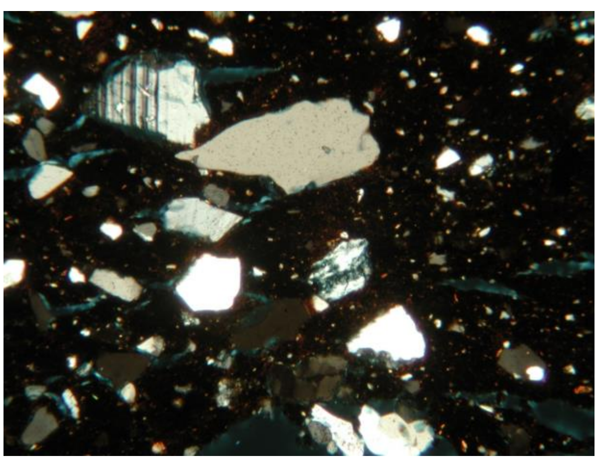

Figure 2. Thin-section photomicrograph of typical Lake Ejagham sediment observed in this study. Medium and coarse, angular and sub-angular quartz grains and twinned feldspar grains are embedded in a dark, clay matrix containing fine quartz silt. Note the bimodal size distribution of grains in the matrix. Width of field of view is 360 μm.

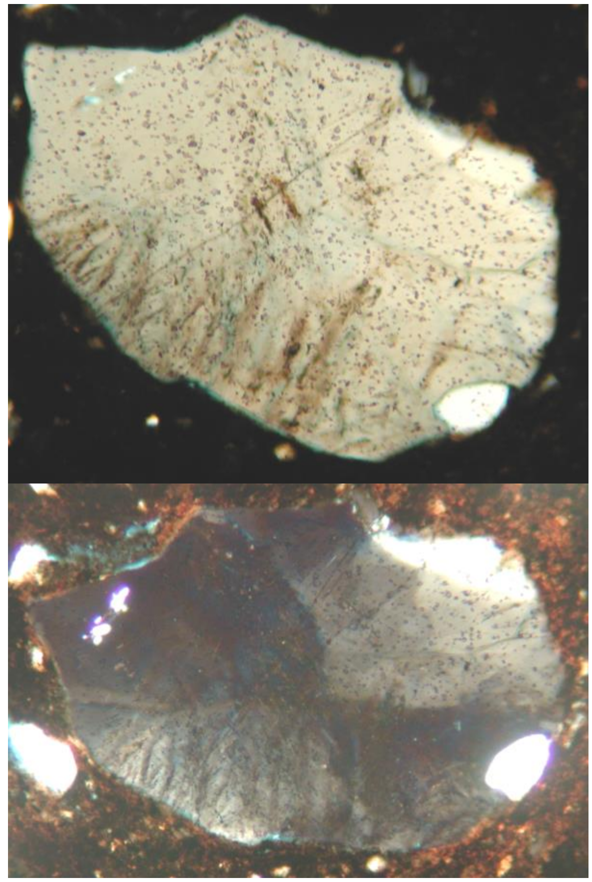

Figure 3. Pair of thin-section photomicrographs of a medium quartz grain from Lake Ejagham. Upper is plane light; lower is crossed-polarized light. This polycrystalline, sub-angular quartz grain contains curviplanar fractures with abundant sub-micron fluid inclusions. A browning effect, what we refer to as possible toasting, is evident along the fractures in the plane light view. Undulose extinction is evident in the cross-polarized view. Width of field of view is 120 microns.

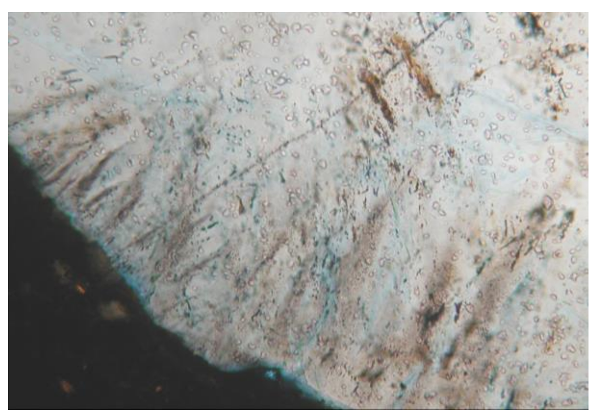

Figure 4. Enlargement of part of the upper view in Figure 2 showing the possible toasting effect. Width of field of view is 85 microns.