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Chrysophycean stomatocysts from the Aershan Geological Park (Inner Mongolia), China

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Abstract

The Aershan National Geological Park (46–47° 39' N, 119–121° 28' E) characterized by volcanic landforms clusters is situated in south-west of the Great Xing'an Mountains. The investigation of chrysophycean stomatocysts was carried out based on sampling five times in this area. 171 morphotypes which were observed using scanning electron microscopy were identified and described in accordance with the guidelines of International Statospore Working Groupm (ISWG), 73 of them are new to science. It is hard to compare the stomatocysts community with that of other areas for the large number of unknown morphotypes, which indicated that amounts of study of stomatocysts morphology should be done in the whole Great Xing'an Mountains.

Keywords: Arshaan, Chrysophyte, cyst, Greater Higgnan Mountains

Table of contents

Introduction

The silicified stomatocyst is the obligate and characteristic stage in the life history of the Chrysophyceae and Synurophyceae (Kristiansen 2005). The stomatocyst morphology, which is resistant to dissolution, is species-specific. They can be used as indicators of environmental change as well as the siliceous scales, bristles and spines. Only *ca.* 20% of known chrysophycean species possess scales. Stomatocysts formed by all chrysophyte taxa could provide a more complete record of the entire chrysophyte community (Duff *et al.* 1995). The potentialities of chrysophycean stomatocysts as paleolimnological indicators were recognized by Nygaard (1956), since then they have been attracting more attention. Gritten (1977) firstly studied stomatocysts with Scanning Electron Microscope (SEM). The International Statospore Working Group standardized the nomenclature and terminology of chrysophycean stomatocysts (Cronberg & Sandgren 1986). The terminology was further elaborated and modified by Duff *et al.* (1995) and Wilkinson *et al.* (2001). Since the seventies, hundreds of morphotypes have been reported from different regions in the world, such as America (Mahood & Adam 1979, Adam 1980, 1981, Adam & Mahood 1980, 1981, Adam & Mehringer 1980, Carney & Sandgren 1983), Antarctic (Van de Vijver & Beyens 1997a, 1997b, 2000), Arctic (Duff *et al.* 1995, Gilbert *et al.* 1997, Betts-Piper *et al.* 2004), Azores (Hansen 2001), Lake Baikal (Firsova & Likhoshway 2006), Canada (Rybak *et al.* 1991, Duff *et al.* 1995, Wilkinson *et al.* 2001), Egypt (Piatek *et al.* 2009), central Europe (Facher & Schmidt 1996; Huber *et al.* 2009), Pyrenees (Pla 2001) and Poland (Cabala 2002, 2003, Wołowski *et al.* 2004). The study of stomatocyst in China was just started from 2012 (Pang *et al.* 2012a, b).

The Aershan National Geological Park (46–47° 39' N, 119–121° 28' E) characterized by volcanic landforms clusters is situated in south-west of the Great Xing'an Mountains with a mean elevation of 1000 m a.s.l. The climate is cold and wet, and the mean annual temperature is -3.2° C and the mean annual precipitation is 448.8mm. Two rivers and more than ten volcanic lakes are located in the park. Lots of bogs and ponds from eutrophic to oligotrophic distribute the whole area. It is a very good habitat for chrysophytes and other algae. 33 morphotypes of chrysophycean stomatocysts were reported from here (Pang *et al.* 2012a, b, Pang & Wang 2013), which are a part of the whole stomatocysts community.

A total of 171 stomatocyst morphotypes, including 73 new morphotypes, were described in this work. It is very hard to compare the stomatocysts community with that of other areas for the large number of unknown morphotypes, such as Azores which is also largely of volcanic origin, containing lots of ponds and lakes, *Sphagnum* bogs and shrub-covered swamps (Hansen 2001). Only 11 stomatocysts we described were reported from Azores. Most of the reports of the stomatocyst morphology included new types, and more than 400 types of stomatocysts from different areas and various habitats have been described. It is indicated that more new morphotypes are to be found in the future. Further studies of stomatocysts morphology, unknown or known, should be done in the whole Great Xing'an Mountain. The research should also cover the wetlands of the Northeast China which has a large wetland typology diversity, being also the largest wetland area of China.

Cyst morphology is believed to be species-specific, but only a few stomatocysts have been linked to the chrysophyte species that produced them. Most of these links are provided only by line drawings (Duff *et al.* 1995). Most biological affinities of the stomatocysts in this study, like those in other studies, remain unknown, and the taxonomy which classified them into several groups based on the morphology of pore, collar and ornamentation is very artificial. Cysts at primary or intermediate stages of development may be distinct from mature cysts within the same species (Duff *et al.* 1995), such as the immature Stomatocysts 22, 66, 75, 103 in this study presenting smooth or weak ornamentation. The mature cysts may vary due to either genetic or environmental factors (Sandgren 1983). For example, the Stomatocyst 6 is ornamented with long echinate spins, or short pronged spines, or conula, or ridges. The stomatocysts morphotypes of *Synura pertersenii* f. *bjoerkii* Cronberg & Kristiansen (1980: 612) and *Synura pertersenii* f. *truttae* Siver (1987: 111)are different, which might indicate that cyst morphology might be subspecies-specific or *forma*-specific (Pang *et al.* 2012c). Although the numerical system devised by the ISWG is helpful when chrysophycean stomatocysts are used as powerful markers of environmental change, it is still necessary to study the encystment mechanisms of chrysophytes not only for their application to environmental change research but to the taxonomy.

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References

Adam, D.P. (1980) Scanning electron micrographs of modern chrysomonad cysts from Haypress Meadows, Eldorado County, California. *United States Geological Survey Open-file Report* 80(1235): 1–15.

Adam, D.P. (1981) Scanning electron micrographs of modern and late Holocene chrysomonad cysts from Harden Lake Meadowm Yosemite National Park, California. *United States Geological Survey Open-file Report* 81(46): 1–23.

Adam, D.P. & Mahood, A.D. (1980) Modern chrysomonad cysts from Fallen Leaf Lake, Eldorado County, California. *United States Geological Survey Open-file Report* 80(798): 1–9

Adam, D.P. & Mahood, A.D. (1981) Scanning electron micrographs of chrysomonad cysts from Lake Aloha, Eldorado County, California. *U.S. Geological Survey Open-file Report* 81(45): 1–12.

Adam, D.P. & Mehringer, Jr. (1980) Modern and Holocene chrysomonad cysts from Lost Trail Pass Bog, Montana. *United States Geological Survey Open-file Report* 80(797): 1–13.

Asmund, B. (1959) Electron microscope observations on Mallomonas species and remarks on their occurrence in some Danish ponds and lakes III. *Dansk Botanisk Arkiv* 18: 1–50.

Asmund, B. & Takahashi, E. (1969) Studies on Chrysophyceae from some ponds and lakes in Alaska VIII. Mallomonas species examined with the electron microscope II. *Hydrobiologia* 34: 305–321. http://dx.doi.org/10.1007/BF00045390

Betts-Piper, A.M., Zeeb, B.A. & Smol, J.P. (2004) Distribution and autecology of chrysophyte cysts from high Arctic Svalbard lakes: preliminary evidence of recent environmental change. *Journal of Paleolimnology* 31: 467–481. http://dx.doi.org/10.1023/B:JOPL.0000022546.21996.41

Bourrelly, P. (1957) Recherches sur les Chrysophycées. *Revue Algologiue Mémoire Hors-Série* 1: 1–409.

Brown, K.M., Douglas, M.S.V. & Smol, J.P. (1994) Siliceous microfossils in a Holocene, high arctic peat deposit (Nordvestø, northwestern Greenland). *Canadian Journal of Botany* 72: 208–216. http://dx.doi.org/10.1139/b94-029

Brown, K.M., Zeeb, B.A., Smol, J.P. & Pienitz, R. (1997) Taxonomic and ecological characterization of chrysophyte stomatocysts from northwestern Canada. *Canadian Journal of Botany* 75: 842–863. http://dx.doi.org/10.1139/b97-094

Carney, H.J. & Sandgren, C.D. (1983) Chrysophycean cysts: indicators of eutrophication in the recent sediments of Frains Lake, Michigan, U.S.A. *Hydrobiologia* 101: 195–202. http://dx.doi.org/10.1007/BF00009875

Carney, H.J., Whiting, M.C., Duff, K.E. & Whitehead, D.R. (1992) Chrysophycean cysts in Sierra Nevada (California) lake sediments: paleoecological potential. *Journal of Paleolimnology* 7: 73–94. http://dx.doi.org/10.1007/BF00197032

Cabala, J. (2002) Chrysophyceae stomatocysts from Budzyn peat bog (Krakow-Czestochowa Upland, Poland). *Polish Botanical Journal* 47: 21–35.

Cabala, J. (2003) New and rare morphotypes of chrysophycean stomatocysts from Poland. *Nova Hedwigia* 77: 99–107.

Cabala, J. & Piatek, M. (2004) Chrysophycean stomatocysts from the Staw Toporowy Nizni lake (Tatra National Park, Poland). *Annales de Limnologie-International Journal of Limnology* 40(2): 149–165. http://dx.doi.org/10.1051/limn/2004013

Coradeghini, A. & Vigna, M.S. (2008) The aerial epiphytic stomatocyst flora (Chrysophyceae and Synurophyceae) of mosses from Primavera Station, Antarctica. *Nova Hedwigia* 86: 401–417. http://dx.doi.org/10.1127/0029-5035/2008/0086-0401

Cronberg, G. (1973) Development of cysts in *Mallomonas eoa* examined by scanning electron microscopy. *Hydrobiologia* 43: 29–38. http://dx.doi.org/10.1007/BF00014254

Cronberg G. (1980) Cyst development in different species of *Mallomonas* (Chrysophyceae) studied by scanning electron microscopy. *Archiv für Hydrobiology Supplement* 56: 421–434.

Cronberg, G. (1988) Variability in size and ultrastructure of the statospore of *Mallomonas caudata*. *Hydrobiologia* 161: 31–39. http://dx.doi.org/10.1007/978-94-009-3097-1_2

Cronberg, G. (1989) Stomatocysts of *Mallomonas hamata* and *M. heteropina* (Mallomonadaceae, Synurophyceae) from South Swedish lakes. *Nordic Journal of Botany* 8: 683–692. http://dx.doi.org/10.1111/j.1756-1051.1989.tb01745.x

Cronberg, D. & Kristiansen, J. (1980) Synuraceae and other Chrysophycea from central Småland, Sweden. *Botaniska Notiser* 133: 595–618.

Cronberg, D. & Sandgren, C.D. (1986) A proposal for the development of standardized nomenclature and terminlology for chrysophycean statospores. *In*: Kristiansen, J. & Andersen, R.A. (Eds.) *Chrysophytes*: *Aspects and Problems*. Cambridge University Press, Cambridge, pp. 317–328.

Donaldson, D.A. & Stein, J.R. (1984) Indentification of planktonic Mallomonadaceae and other Chrysophyceae from selected lakes in the lower Fraser Valley, British Columbia (Canada). *Canadian Journal of Botany* 62: 525–539. http://dx.doi.org/10.1139/b84-078

Duff, K.E. & Smol, J.P. (1989) Chrysophycean stomatocysts from the postglacial sediments of Tasikutaaq Lake, Baffin Island, N.W.T. *Canadian Journal of Botany* 67(6): 1649–1656. http://dx.doi.org/10.1139/b89-208

Duff, K.E. & Smol, J.P. (1991) Morphological descriptions and stratigraphic distributions of the chrysophycean stomatocysts from a recently acidified lake (Adirondack Park, N.Y.). *Journal of Paleolimnology* 5: 73–113. http://dx.doi.org/10.1007/BF00226558

Duff, K.E. & Smol, J.P. (1994) Chrysophycean cyst flora from British Columbia (Canada) lakes. *Nova Hedwigia* 58: 353–389.

Duff, K.E., Douglas, M.S.V. & Smol, J.P. (1992) Chrysophyte cysts in 36 Canadian high arctic ponds. *Nordic Journal of Botany* 12(4): 471–499. http://dx.doi.org/10.1111/j.1756-1051.1992.tb01331.x

Duff, K.E., Zeeb, B.A. & Smol, J.P. (1995) *Altas of Chrysophycean Cysts.* Kluwer Academic Publishers, Dordrecheight, 189 pp.

Ehrenberg, C.G. (1834) Dritter Beitrag zur Erkenntniss grosser Organisation in der Richtung des kleinsten Raumes. *Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin* 1833: 145–336.

Facher, E. & Schmidt, R. (1996) A siliceous chrysophycean cyst-based pH transfer function for Central European lakes. *Journal of Paleolimnology* 16: 275–321. http://dx.doi.org/10.1007/BF00207575

Firsova, A.D. & Likhoshway, Y.V. (2006) *Atlas of Chrsophycean Cysts of Lake Baikal*. Nauka, Novosibirsk, 147 pp.

Frenguelli, J. (1936) Crisostomatáceas del Neuquén. *Notas del Museo de la Plata* 1: 247–275.

Gilbert, S., Zeeb, B.A. & Smol, J.P. (1997) Chrysophyte stomatocyst flora from a forest peat core in the Lena River Region, northeastern Siberia. *Nova Hedwigia* 64: 311–352.

Gritten, M.M. (1977) On the fine structure of some chrysophycean cysts. *Hydrobiologia* 53(3): 239–252. http://dx.doi.org/10.1007/BF00818546

Hansen, P. (2001) Chrysophyte stomatocysts in the Azores-biogeographical implications and 110 new morphotypes. *Opera Botanica* 138: 1–96.

Huber, K., Kamenik, C., Weckström, K. & Schmidt, R. (2009) Taxonomy, stratigaphy, and palaeoecology of chrysophyte cysts from a Late Glacial sediment core section of Längsee, Austria. *Nova Hedwigia* 89: 245–261. http://dx.doi.org/10.1127/0029-5035/2009/0089-0245

Imhof, O.E. (1887) Studien über die Fauna hochalpiner Seen insbesonder des Kantons Graubünden. *Jahresbericht der Naturhistorischen Gesellschaft Graubünden* 30: 145-164.

Iwanoff, L. (1899) Beitrag zur Kenntnis der Morphologie und Systematik der Chrysomonadinen. *Bulletin de l'Académie Impériale des Sciences de Saint Pétersbourg* 11: 247–262.

Kamenik, C., Agustí-Panareda, A., Appleby, P.G., Dearing, J.A., Shilland, E.M., Šporka, F., Štefková, E. & Thompson, R. (2005) Paleolimnological evidence for atmospheric pollution, climate and catchment-related changes in alpine chrysophyte stomatocyst assemblages (Tatra, Slovakia). *Nova Hedwigia Beiheft* 128: 275–293.

Kristiansen, J. (1980) Chrysophyceae from some Greek lakes. *Nova Hedwigia* 33: 167–194.

Kristiansen, J. (2005) *Golden Algae-A Biology of Chrysophytes.* A.R.G. Gantner Verlag Kommanditgesellschaft, Ruggell, 167 pp.
Korshikov, A.A. (1942) On some new or little known flagellates. *Archiv für Protistenkunde* 95: 22–44.
Lund, J.W.G. (1942) Contributions to the knowledge of British Chrysophyceae. *New Phytologist* 41: 274–292. http://dx.doi.org/10.1111/j.1469-8137.1942.tb07079.x
Mahood, A.D. & Adam, D.P. (1979) Late Pleistocene cysts from core 7, Clear Lake, Lake County, California. *United States Geological Survey Open-file Report* 79–791.
Nicholls, K.H. (1980) A reassessment of *Chrysosphaerella longispina* and *C. multispina*, and a revised key to related genera in the Synuraceae (Chrysophyceae). *Plant Systematics and Evolution* 135: 95–106. http://dx.doi.org/10.1007/BF00983010
Nygaard, G. (1949) Hydrobiological studies on some Danish ponds and lakes. Part 2. The quotient hypothesis and some new or little known phytoplankton organisms. *Det Kongelige Danske Videnskabernes Selskab, Biologiske Skrifter* 7: 1–293.
Nygaard, G. (1956) The ancient and recent flora of diatoms and Chrysophyceae in Lake Gribsø. *Folia limnologica Scandinavica* 8: 32–93.
Pang, W. & Wang, Q. (2013) Chrysophycean stomatocysts from the Stone Ponds in the Aershan National Geological Park, China. *Nova Hedwigia Beiheft* 142: 51–67.
Pang, W., Wang, Y. & Wang, Q. (2012a) Ten new stomatocysts ornamented with spines from the bogs near Da'erbin Lake, China. *Nova Hedwigia* 94(1): 193–207. http://dx.doi.org/10.1127/0029-5035/2012/0094-0193
Pang, W., Wang, Y. & Wang, Q. (2012b) Six new chrysophycean stomatocysts ornamented with reticulum from the Great Xing'an Mountains, China. *Chinese Journal of Oceanology and Limnology* 30(3): 410–412. http://dx.doi.org/10.1007/s00343-012-1164-1
Pang, W., Wang, Y. & Wang, Q. (2012c) Stomatocyst of *Synura petersenii*. *Acta Botaniica Boreali-Occidentalia Sinica* 32(5): 921–923.
Pascher, A. (1913) Chrysomonadinae. *In*: Pascher, A. (Eds.) *Die Süßwasser-Flora Deutchlands, Österreichs und der Schweiz 2*. G. Fischer, Jena, pp. 7–95. http://dx.doi.org/10.5962/bhl.title.21607
Piatek, J. (2006) Stomtocysts of the Dolina Gasienicowa Valley in the Tatra Mts (Poland). 1. Czarny Staw Gasienicowy and Zmarzly Staw Gasienicowy Lakes. *Polish Botanical Journal* 51(1): 61–77.
Piatek, J. (2007) Chrysophyte stomatocysts from sediments in a man-made water reservoir in central Poland. *Annales Botanici Fennici* 44: 186–193.
Piatek, J. & Piatek, M. (2005) Chrysophyte stomatocysts of the sulphuric salt marsh in the Owczary Reserve (central Poland). *Polish Botanical Journal* 50(1): 97–106.
Piatek, J. & Piatek, M. (2008) Chrysophyte stomatocysts from gypsum damp vegetation in southern Poland. *Polish Botanical Journal* 53(1): 57–67.
Piatek, J., Piatek, M., Zeeb, B.A. & Shahed, A.E. (2009) Chrysophyte stomatocysts in Africa: the first description of an assemblage in the recent sediments of a thermo-mineral spring in Egypt. *Phycologia* 48: 13–23. http://dx.doi.org/10.2216/08-50.1
Pienitz, R., Walker, I.R., Zeeb, B.A., Smol, J.P. & Leavitt, P.R. (1992) Biomonitoring past salinity changes in an athalassic subarctic lake. *International Journal of Salt Lake Research* 1: 91–123. http://dx.doi.org/10.1007/BF02904364
Pla, S. (2001) Chrysophycean cysts from the Pyrenees. *Bibliotheca Phycologia* 109: 1–179.
Płachno, B.J. & Wołowski, K. (2008) Algae commensal community in Genlisea traps. *Acta Societatis Botanicorum Poloniae* 77: 77–86. http://dx.doi.org/10.5586/asbp.2008.011
Rybak, M. (1987) Fossil chrysophycean cyst flora of Racze Lake, Wolin Island (Poland) in relation to paleoevironmental conditions. *Hydrobiologia* 150: 257–272. http://dx.doi.org/10.1007/BF00008707
Rybak, M., Rybak, I. & Dickmann, M. (1987) Fossil chrysophycean cyst flora in a small meromictic lake in southern Ontario, and its paleoecological interpretation. *Canadian Journal of Botany* 65: 2425–2440. http://dx.doi.org/10.1139/b87-330
Rybak, M., Rybak, I. & Nicholls, K. (1991) Sedimentary chrysophycean cyst assemblages as paleoindictors in acid sensitive Lakes. *Journal of Paleolimnology* 5: 19–72. http://dx.doi.org/10.1007/BF00226557
Sandgren, C.D. (1983) Morphological variability in populations of chrysophycean resting cysts. I. Genetic (interclonal) and encystment temperature effects on morphology. *Journal of Phycology* 19: 64–70. http://dx.doi.org/10.1111/j.0022-3646.1983.00064.x
Sandgren, C.D. (1989) SEM investigations of statospore (stomatocyst) development in diverse members of the Chrysophyceae and Synurophyceae. *Nova Hedwigia Beiheft* 95: 45–69.
Sandgren, C.D. & Carney, H.J. (1983) A flora of fossil chrysophycean cysts from the recent sediments of Frains Lake, Michigan, U.S.A. *Nova Hedwigia* 38: 129–163.
Siver, P.A. (1987) The distribution and variation of *Synura* species (Chrysophyceae) in Connecticut, USA. *Nordic Journal of Botany* 7: 107–116. http://dx.doi.org/10.1111/j.1756-1051.1987.tb00922.x
Siver, P.A. (1991) The distribution of chrysophytes along environmental gradients: their use as biological indicators. *In*: Kristiansen, J.

& Andersen, R.A. (Eds.) *Chrysophytes: Aspects and Problems.* Cambridge University Press, Cambridge, pp. 232–268.
http://dx.doi.org/10.1017/CBO9780511752292.012
Szeicz, J.M., Zeeb, B.A., Bennett, K.D. & Smol, J.P. (1998) High-resolution paleoecological analysis of recent disturbance in a southern Chilean *Nothofagus* forest. *Journal of Paleolimnology* 20: 235–252.
http://dx.doi.org/10.1023/A:1007950905200
Van de Vijver, B. & Beyens, L. (1997a) The subfossil Chrysophyte cyst flora of some peat samples from Kerguelen Islands. *Archiv für Protistenkunde* 148: 491–503.
http://dx.doi.org/10.1016/s0003-9365(97)80024-3
Van de Vijver, B. & Beyens, L. (1997b) The chrysophyte stomatocyst flora of the moss vegetation from Strømness Bay area, South Georgia. *Archiv für Protistenkunde* 148: 505–520.
http://dx.doi.org/10.1016/s0003-9365(97)80026-7
Van de Vijver, B. & Beyens, L. (2000) Chrysophycean stomatocysts from freshwater habitats of the Strømness Bay area, South Georgia, Antarctica. *Canadian Journal of Botany* 78: 88–97.
http://dx.doi.org/10.1139/b99-165
Vigna, M.S. (1984) Estudio de la estatospora de Mallomonas areolata Nygaard con microscopio electrónico de barrido (Chirysophyceae). *Physis Secciones A, B y C* 42: 99–101.
Vorobyova, S.S., Pomazkina, G.V., Baranova, E.Yu., Likhoshway Ye.V. & Sandgren, C.D. (1996) Chrysophycean cyst (stomatocysts) from Lake Baikal and Irkustsk Reservoir, Siberia. *Journal of Paleolimnology* 15: 271–277.
http://dx.doi.org/10.1007/BF00213046
Wilkinson, A.N. & Smol, J.P. (1998) Chrysophycean stomatocyst flora from south-central Ontario lakes. *Canadian Journal of Botany* 76: 836–862.
http://dx.doi.org/10.1139/b98-052
Wilkinson, A.N., Zeeb, B.A., Smol, J.P. & Douglas, M.S.V. (1997) Chrysophyte stomatocyst assemblages associated with periphytic, high arctic pond environment. *Nordic Journal of Botany* 17: 95–112.
http://dx.doi.org/10.1111/j.1756-1051.1997.tb00293.x
Wilkinson, A.N., Zeeb, B.A. & Smol, J.P. (2001) *Atlas of Chrysophycean Cysts-Vol ?.* Kluwer Academic Publishers, Dordrecheight, 169 pp.
Wołowski, K., Cabala, J. & Zeeb, B.A. (2004) Chrysophycean stomatocysts from a karstic sinkhole in the vicinity of Staszow on the Malopolska Upland, Poland. *Canadian Journal of Botany* 82: 1330–1337.
http://dx.doi.org/10.1139/b04-089
Wołowski, K., Piatek, J. & Płachno, B.J. (2011) Algae and stomatocysts associated with carnivorous plants. First report of chrysophyte stomatocysts from Virginia, USA. *Phycologia* 50: 511–519.
http://dx.doi.org/10.2216/10-94.1
Zeeb, B.A. & Smol, J.P. (1993) Chrysophycean stomatocyst flora from Elk Lake, Clearwater County, Minnesota. *Canadian Journal of Botany* 71: 737–756.
http://dx.doi.org/10.1139/b93-086
Zeeb, B.A., Duff, K.E. & Smol, J.P. (1990) Morphological descriptions and stratigraphic profiles of chrysophycean stomatocysts from the recent sediments of Little Round Lake, Ontario. *Nova Hedwigia* 51: 361–380.
Zeeb, B.A., Smol, J.P. & VanLandingham, S.L. (1996a) Pliocene chrysophycean stomatocysts from the Sonoma volcanics, Napa County, California. *Micropaleontology* 42: 79–91.
http://dx.doi.org/10.2307/1485985
Zeeb, B.A., Smol, J.P. & Horn, S.P. (1996b) Chrysophycean stomatocysts from Costa Rican tropical lake sediments. *Nova Hedwigia* 63: 279–299.

Index