Supplementary file

Schmitz, B., Schmieder, M., Liao, S., Martin, E., and Terfelt, F., 2022, Impact-crater ages and micrometeorite paleofluxes compared: Evidence for the importance of ordinary chondrites in the flux of meteorites and asteroids to Earth the past 500 million years, *in* Koeberl, C., Claeys, P., and Montanari, A., eds., From the Guajira Desert to the Apennines, and from Mediterranean Microplates to the Mexican Killer Asteroid: Honoring the Career of Walter Alvarez: Geological Society of America Special Paper 557, https://doi.org/10.1130/2022.2557(18).

Text and Table S1 and S2

At least 20 terrestrial impact structures have proven or likely Ordovician stratigraphic and/or isotopic ages, most of which appear to postdate the ~470 Ma breakup of the L-chondrite parent body (LCPB) (e.g., Schmitz et al. 2001, 2008; Korochantseva et al., 2007; Swindle et al., 2014; Liao et al. 2020). These impact structures are, in the United States: Rock Elm, Ames, Decorah, Calvin, and Glasford (Buschbach and Ryan, 1963; Cordua, 1985; Milstein, 1994; Koeberl et al., 2001; French et al., 2004, 2018; Monson et al., 2019); on the Canadian Shield: East Clearwater Lake, Brent, La Moinerie, Slate Islands, Pilot, Charlevoix, and Tunnunik (Canada; Bottomley et al. 1990; Grahn and Ormö, 1996; Sharpton et al., 1997; Grieve, 2006; Lepaulard et al., 2019; Schmieder et al., 2015, 2019; McGregor et al., 2019, 2020); in Baltoscandia: Kärdla (Estonia; Grahn et al., 1996), Granby, Hummeln, Tvären, Lockne, and Målingen (Sweden; Ormö 1994; Grahn et al., 1996; Grahn, 1997; Alwmark, 2009; Ormö et al., 2014; Alwmark et al., 2015); on the Ukrainian Shield: Ilyinets (Pesonen et al., 2004); and in Australia: Lawn Hill (Darlington et al., 2016). The mid-Ordovician Osmussaar Breccia (Estonia; Alwmark et al., 2010) has a similar stratigraphic age, but its source crater is currently unknown. The relatively large, ~50 km-diameter Carswell impact structure, Canada, with an early Ordovician ^{40}Ar–^{39}Ar age of 481.5 ± 0.8 Ma (Alwmark et al., 2017), seemingly predates the LCPB breakup event by a few Myr. Likewise, the Newporte (USA) and Mizarai (Lithuania) impact structures both have stratigraphic ages that span the late Cambrian and early Ordovician (Koeberl and Reimold, 1995; Masaitis, 1999; Abels et al., 2002). The Crooked Creek, Glover Bluff (USA), and Lumparn (Finland) impact structures have Ordovician stratigraphic maximum ages but may be younger (Snyder and Gerdemann, 1965; Merrill, 1980; Read, 1983; Bottomley et al., 1990; Abels, 2003); the Lac Couture impact structure (Canada) has an Ordovician to early Devonian ^{40}Ar–^{39}Ar age (Bottomley et al., 1990; Grieve, 2006).

Some stratigraphically constrained impact ages are remarkably precise, such as that of the ~14 km-diameter marine Lockne impact structure of Central Sweden. Because the youngest pre-impact and oldest post-impact sediments both lie in the late Sandbian (early Caradocian; Cohen et al., 2013) lower *Lagenochitina dalbyensis* chitinozoan microfossil zone, which has been studied micropaleontologically in detail (Grahn et al., 1996; Grahn, 1997; Ormö et al., 2014), the impact age can be constrained to ~455 Ma plus/minus approximately 1 Myr. The crater-filling post-impact deposits of the so-called Winneshiek Shale that occurs within the ~5.5 km-diameter Decorah impact structure in Iowa, USA, suggests a middle Ordovician (Darriwilian) age of ~467–464 Ma for the deposition of the shale and, by inference, the slightly older impact (Bergström et al., 2018). This age, obtained through high-precision chemostratigraphic ($\delta^{13}C_{org}$) correlation, is within uncertainty identical to the ages of a number of impact structures and fossil L-chondrites found in Sweden (e.g., Schmitz et al., 2001).

Uranium-lead ages were obtained via laser ablation inductively coupled plasma mass spectrometry (LA–ICP–MS) for shocked zircon in impact melt rock from the ≥54 km-diameter Charlevoix impact structure in Canada (Schmieder et al., 2019). The recently obtained U–Pb zircon age of 450 ± 20 Ma spans into the Silurian; however, because of concordant U–Pb laser spot results around ~450 Ma for zircon, the partial overthrusting of the Charlevoix impact structure along the (Ordovician) Taconian front of the Appalachian nappes, and taking into account previous $^{40}Ar/^{39}Ar$ geochronologic results (Whitehead et al., 2003; Kelley, 2006), Schmieder et al. (2019) tend to favor a Late Ordovician age for the Charlevoix impact, which has a stratigraphic maximum age of ~454 Ma based on the occurrence of shatter-coned limestone. Using a different U-baring target mineral, LA-ICP–MS analysis of shocked and age-reset apatite grains by McGregor et al. (2019) yielded an Ordovician isotopic age of 453 ± 5 Ma for the La Moinerie impact structure, also located in Canada.

Several older ^{40}Ar–^{39}Ar ages, such as the results of Bottomley et al. (1990) for a number of Canadian impact structures, have been recalculated using the revised K decay constants and standard (neutron fluence monitor) ages of Renne et al. (2010, 2011) and the ArAR tool of Mercer and Hodges (2016), so that the resultant ages are directly comparable to modern U–Pb ages. For example, the age of 445 ± 2 Ma of Bottomley et al. (1990) for the Pilot impact structure, Canada, which was calculated using an age of 1071 ± 7 Ma for the Hb3gr (hornblende from the Lone Grove granite pluton, Texas, USA) dating standard and the K decay constants of Steiger and Jäger (1977; $\lambda_\varepsilon = 0.581 \pm 0.00581 \times 10^{-10}\ a^{-1}$; $\lambda_\beta = 4.962 \pm 0.04962 \times 10^{-10}\ a^{-1}$) becomes 450 ± 2 Ma after recalculation (revised Hb3gr age: 1081 ± 1.2 Ma; revised K decay constants: $\lambda_\varepsilon = 0.5757 \pm 0.0016) \times 10^{-10}\ a^{-1}$; $\lambda_\beta = 4.9548 \pm 0.0134 \times 10^{-10}\ a^{-1}$; Renne et al., 2011, see also Schwarz et al., 2011; Mercer and Hodges, 2016). Errors on U–Pb and ^{40}Ar–^{39}Ar impact ages are, unless otherwise noted, given at the 2σ (~95% confidence) level.

In addition to the proven impact structures listed above, a number of possible and likely impact structures have been proposed (e.g., Schmieder et al., 2015, their Table 3). These are the Dycus, Howell, Jeptha Knob, Peerless, and Versailles structures in the United States (Born and Wilson, 1939; Black, 1964; O'Connell, 1965; Seeger, 1968; Comstock et al., 2004; Herrmann and Mayne, 2011; Maione, 2015) and the Banat Baqar and Jalamid structures in Saudi Arabia (Neville et al., 2014). However, geologic evidence for an impact origin of these enigmatic structures is, at this point, still unconvincing. We would like to point out that our impact crater density reconstructions are entirely based on the confirmed Ordovician impact cratering record, clearly separating proven from potential terrestrial impact sites. A list summarizing all confirmed terrestrial impact structures and deposits of proven and likely Ordovician age is provided in Table S1. Candidate impact structures with (likely) Ordovician ages are listed in Table S2.

References within supplementary file:

Abels, A. (2003) *Investigation of impact structures in Finland (Söderfjärden, Lumparn, Lappajärvi) by digital integration of multidisciplinary geodata*. Doctoral thesis, Westfälische Wilhelms-Universität, Münster, Germany, 321 pp.

Abels, A., Plado, J., Pesonen, L.J., and Lehtinen, M. (2002) The impact cratering record of Fennoscandia – A close look at the database. In *Impacts in Precambrian shields*, edited by J. Plado and L. J. Pesonen, Springer, Berlin, Heidelberg, pp 1–58.

Alwmark, C. (2009) Shocked quartz grains in the polymict breccia of the Granby structure, Sweden–-Verification of an impact. *Meteorit. Planet. Sci.* 44:1107–1113.

Alwmark, C., Schmitz, B., and Kirsimäe, K. (2010) The mid-Ordovician Osmussaar breccia in Estonia linked to the disruption of the L-chondrite parent body in the asteroid belt. *GSA Bull.* 122:1039–1046.

Alwmark, C., Ferrière, L., Holm-Alwmark, S., Ormö, J., Leroux, H., and Sturkell, E. (2015) Impact origin for the Hummeln structure (Sweden) and its link to the Ordovician disruption of the L chondrite parent body. *Geology* 43:279–282.

Alwmark, C., Bleeker, W., LeCheminant, A., Page, L., and Scherstén, A. (2017) An Early Ordovician ^{40}Ar-^{39}Ar age for the ∼50 km Carswell impact structure, Canada. *GSA Bull.* 129:1442–1449.

Bergström, S.M., Schmitz, B., Liu, H.P., Terfelt, F. and McKay, R.M., 2018. High-resolution $\delta^{13}C_{org}$ chemostratigraphy links the Decorah impact structure and Winneshiek Konservat-Lagerstätte to the Darriwilian (Middle Ordovician) global peak influx of meteorites. *Lethaia*, 51(4), pp.504-512.

Bottomley, R. J., York, D., and Grieve, R.A.F. (1990) ^{40}Argon-^{39}Argon dating of impact craters. *Proc. Lunar Planet. Sci. Conf.* 20:421–431.

Buschbach, T.C. and Ryan, R. (1963) Ordovician explosion structure at Glasford, Illinois. *AAPG Bull.* 47:2015–2022.

Cohen, K.M., Finney, S.C., Gibbard, P.L., and Fan, J.-X. (2013; updated) The ICS International Chronostratigraphic Chart, v. 2018/08. *Episodes* 36:199-204.

Cordua, W.S. (1985) Rock Elm structure, Pierce county, Wisconsin: a possible cryptoexplosion structure. *Geology* 13:372–374.

Darlington, V., Blenkinsop, T., Dirks, P., Salisbury, J., and Tomkins, A. (2016) The Lawn Hill annulus: An Ordovician meteorite impact into water-saturated dolomite. *Meteorit. Planet. Sci.* 51:2416–2440.

French, B. M. (2004) The importance of being cratered: The new role of meteorite impact as a normal geological process. *Meteorit. Planet. Sci.* 39:169–197.

French, B.M., McKay, R.M., Liu, H.P., Briggs, D.E., and Witzke, B.J. (2018) The Decorah structure, northeastern Iowa: geology and evidence for formation by meteorite impact. *GSA Bull.* 130:2062–2086.

Grahn, Y. (1997) Chitinozoan biostratigraphy of the early Caradocian Lockne impact structure, Jämtland, Sweden. *Meteorit. Planet. Sci.* 32:745–751.

Grahn, Y. and Ormö, J. (1995) Microfossil dating of the Brent meteorite crater, southeast Ontario, Canada. *Rev. Micropaléont.* 38:131–137.

Grahn, Y., Nõlvak, J., and Paris, F. (1996) Precise chitinozoan dating of Ordovician impact events in Baltoscandia. *J. Micropalaeontol.* 15:21–35.

Grieve, R. A. F. (2006) *Impact Structures in Canada*. Geol. Assoc. Canada, GEOtext 5, St. John's, 120 pp.

Herrmann, B.C. and Mayne, R.G., 2011, March. Impact at Ingalls? Evidence for Subsurface Ordovician Meteorite Impact Near Ingalls, OK. In Lunar and Planetary Science Conference (Vol. 42, p. 1032).

Kelley, S. P. 2006. Testing for clustering in the terrestrial impact record: progress through dating ancient craters. 40th ESLAB First International Conference on Impact Cratering in the Solar System (May 08–12, 2006, Noordwijk, The Netherlands), Abstract no. 296311.

Koeberl, C. and Reimold, W.U. (1995) The Newporte impact structure, North Dakota, USA. *Geochim. Cosmochim. Acta* 59:4747–4767.

Koeberl, C., Reimold, W.U., and Kelley, S.P. (2001) Petrography, geochemistry, and argon-40/argon-39 ages of impact-melt rocks and breccias from the Ames impact structure, Oklahoma: The Nicor Chestnut 18-4 drill core. Meteorit. Planet. Sci. 36:651–669.

Korochantseva, E.V., Trieloff, M., Lorenz, C.A., Buykin, A.I., Ivanova, M.A., Schwarz, W.H., Hopp, J., and Jessberger, E.K. (2007) L-chondrite asteroid breakup tied to Ordovician meteorite shower by multiple isochron ^{40}Ar-^{39}Ar dating. *Meteorit. Planet. Sci.* 42:113–130.

Lepaulard, C., Gattacceca, J., Swanson-Hysell, N., Quesnel, Y., Demory, F., and Osinski, G. R. (2019) A Paleozoic age for the Tunnunik impact structure. *Meteorit. Planet. Sci.* 54:740–751.

Liao, S., Huyskens, M.H., Yin, Q.-Z., Schmitz, B., 2020, Absolute dating of the L-chondrite parent body breakup with high-precision U-Pb zircon geochronology from Ordovician limestone. Earth and Planetary Science Letters 546, 116442.

Maione, S.J., 2015. Discovery of a Probable Meteorite Impact Site of Late Cambrian− Early Ordovician Age in the Permian Basin, Crockett County, Texas, and its Implications for Hydrocarbon Exploration. Search and Discovery Article #10719, 22 p.

Masaitis, V. L. (1999) Impact structures of northeastern Eurasia: The territories of Russia and adjacent countries. *Meteorit. Planet. Sci.* 34:691–711.

McGregor, M., McFarlane, C.R. and Spray, J.G., 2019. In situ multiphase U–Pb geochronology and shock analysis of apatite, titanite and zircon from the Lac La Moinerie impact structure, Canada. Contributions to Mineralogy and Petrology, 174, 1-20.

McGregor, M., Dence, M.R., McFarlane, C.R. and Spray, J.G., 2020. U–Pb geochronology of apatite and zircon from the Brent impact structure, Canada: a Late Ordovician Sandbian–Katian boundary event associated with L-Chondrite parent body disruption. Contributions to Mineralogy and Petrology, 175, 1-21.

Mercer, C.M. and Hodges, K.V., 2016. ArAR—A software tool to promote the robust comparison of K–Ar and $^{40}Ar/^{39}Ar$ dates published using different decay, isotopic, and monitor-age parameters. *Chemical Geology*, *440*, pp.148-163.

Merrill, G.K. (1980) Ordovician conodonts from the Aaland islands, Finland. *GFF* 101:329–341.

Milstein, R. L. (1994) *The Calvin impact crater, Cass County, Michigan: Identification and analysis of a subsurface Ordovician astrobleme*. Ph.D. thesis, Oregon State University, 126 pp.

Mitchum, R.M., 1951. *The Dycus Disturbance, Jackson County, Tennessee* (Doctoral dissertation, Vanderbilt University), 80 p.

Monson, C.C., Sweet, D., Segvic, B., Zanoni, G., Balling, K., Wittmer, J.M., Ganis, G.R. and Cheng, G., 2019. The Late Ordovician (Sandbian) Glasford structure: A marine-target impact crater with a possible connection to the Ordovician meteorite event. Meteoritics & Planetary Science, 54, 2927-2950.

O'Connell, E., 1965. A Catalog of Meteorite Craters and Related Features, with a Guide to the Literature. The Rand Corp., P-3087, 222 p.

Ormö, J. (1994) The pre-impact Ordovician stratigraphy of the Tvären Bay impact structure, SE Sweden. *GFF* 116:139–144.

Ormö, J., Sturkell, E., Alwmark, C., and Melosh, J. (2014) First known terrestrial impact of a binary asteroid from a main belt breakup event. *Sci. Rep.* 4:6724, 5 pp., doi: 10.1038/srep06724.

Pesonen, L.J., Mader, D., Gurov, E.P., Koeberl, C., Kinnunen, K.A., Donadini, F., and Handler, R. (2004) Paleomagnetism and $^{40}Ar/^{39}Ar$ age determinations of impactites from the Ilyinets structure, Ukraine. In *Cratering in marine environments and on ice*, edited by H. Dypvik, M.J. Burchell, and Ph. Claeys, Springer, Berlin, Heidelberg, pp. 251–280.

Renne, P.R., Mundil, R., Balco, G., Min, K. and Ludwig, K.R., 2010. Joint determination of ^{40}K decay constants and $^{40}Ar^{*}/^{40}K$ for the Fish Canyon sanidine standard, and improved accuracy for $^{40}Ar/^{39}Ar$ geochronology. *Geochim. Cosmochim. Acta 74*:5349–5367.

Renne, P.R., Balco, G., Ludwig, K.R., Mundil, R. and Min, K. (2011) Response to the comment by WH Schwarz et al. on "Joint determination of ^{40}K decay constants and $^{40}Ar^{*}/^{40}K$ for the Fish Canyon sanidine standard, and improved accuracy for $^{40}Ar/^{39}Ar$ geochronology" by PR Renne et al.(2010). *Geochim. Cosmochim. Acta* 75:5097–5100.

Schmieder, M., Kring, D.A., 2020. Earth's impact events through geologic time - A list of recommended ages for terrestrial impact structures and deposits. Astrobiology 20, 91-141.

Schmieder, M., Schwarz, W. H., Trieloff, M., Tohver, E., Buchner, E., Hopp, J., and Osinski, G. R. (2015a) New $^{40}Ar/^{39}Ar$ dating of the Clearwater Lake impact structures (Québec, Canada) – Not the binary asteroid impact it seems? *Geochim. Cosmochim. Acta* 148:304–324.

Schmieder, M., Shaulis, B. J., Lapen, T. J., Buchner, E. and Kring, D. A. (2019) *In situ* U–Pb analysis of shocked zircon from the Charlevoix impact structure, Québec, Canada. *Meteorit. Planet. Sci.* (in press), doi: 10.1111/maps.13315.

Schmitz, B., Tassinari, M., and Peucker-Ehrenbrink, B. (2001) A rain of ordinary chondritic meteorites in the early Ordovician. *Earth Planet. Sci. Lett.* 194:1–15.

Schmitz, B., Harper, D.A., Peucker-Ehrenbrink, B., Stouge, S., Alwmark, C., Cronholm, A., Bergström, S.M., Tassinari, M., and Xiaofeng, W. (2008) Asteroid breakup linked to the Great Ordovician biodiversification event. *Nature Geosci.* 1:49–53.

Schwarz, W.H., Kossert, K., Trieloff, M. and Hopp, J., 2011. Comment on the "Joint determination of ^{40}K decay constants and $^{40}Ar^{*}/^{40}K$ for the Fish Canyon sanidine standard, and improved accuracy for $^{40}Ar/^{39}Ar$ geochronology" by Paul R. Renne et al.(2010). *Geochimica et Cosmochimica Acta*, *75*(17), pp.5094-5096.

Sharpton, V.L., Copeland, P., Dressler, B.O., and Spell, T.L. (1997) New age constraints on the Slate Islands impact structure, Lake Superior, Canada. *Lunar Planet. Sci. Conf.* XXVIII, pp. 1287–1288.

Snyder, F.G. and Gerdemann, P.E., 1965. Explosive igneous activity along an Illinois-Missouri-Kansas axis. *American Journal of Science*, *263*(6), pp.465-493.

Steiger, R. and Jäger, E., 1977. Subcommission on geochronology: convention on the use of decay constants in geo-and cosmochronology. *Earth Planet. Sci. Lett.*, *36*(3), pp.359-362.

Suuroja, K., Kirsimäe, K., Ainsaar, L., Kohv, M., Mahaney, W.C. and Suuroja, S., 2003. The Osmussaar Breccia in Northwestern Estonia—Evidence of a~ 475 Ma Earthquake or an Impact?. In Koeberl, C. and Martinez-Ruiz, F. C. (Eds.) *Impact markers in the stratigraphic record,* Springer, Berlin, Heidelberg, pp. 333–347.

Swindle, T.D., Kring, D.A., and Weirich, J.R. (2014) $^{40}Ar/^{39}Ar$ ages of impacts involving ordinary chondrite meteorites. In *Advances in $^{40}Ar/^{39}Ar$ dating: From Archaeology to Planetary Sciences*, edited by F. Jourdan, D.F. Mark, and C. Verati, Geol. Soc. London Spec. Pub. 378:333–347.

Whitehead, J., Kelley, S. P., Sherlock, S. C., Grieve, R. A. F., Spray, J. G. and Trepmann, C. A. 2003. Structural and geochronologic constraints on the timing of the Charlevoix impact, Quebec, Canada. Large Meteorite Impacts (August 5–7, 2003, Nördlingen, Germany), abstract no. 4084.

Table DR1: Summary of confirmed terrestrial impact structures and deposits*, as well as candidate impact sites of proven and likely Ordovician age. Modified after Schmieder et al. (2015); Schmieder and Kring (2020). Stratigraphic ages were taken from Cohen et al. (2013, updated).

Impact structure	Country	Latitude	Longitude	Diameter (km)	Stratigraphic age constraints	Radioisotopic age constraints	Other age constraints, remarks	Recommended age (Ma)	Age reference	Reported age (Ma) before recalculation
Ames	Oklahoma, USA	N 36°15'	W 98°10'	16	Early–Middle Ordovician (Floian–Darriwilian)			**~478– 458**	Koeberl et al. (2001)	
Brent	Ontario, Canada	N 46°05'	W 78°29'	3.8	Early Caradoc (=Sandbian), conodont and chitinozoan biostratigraphy	U-Pb on zircon and apatite		**458–453** **452.8 ± 2.7**	Grahn & Ormö (1996) McGregor et al. (2020a)	
Calvin	Michigan, USA	N 41°50'	W 85°57'	8.5	Late Ordovician			**458–443**	Milstein (1994)	
Carswell	Saskatchewan, Canada	N 58°27'	W 109°30'	39		Ar-Ar (adularia in impact melt rock)		**481.5 ± 0.8 Ma**	Alwmark et al. (2017)	
Charlevoix	Québec, Canada	N 47°32'	W 70°18'	54		U-Pb (LA-ICP-MS on zircon in impact melt rock)		**~454–430**	Schmieder et al. (2019)	
Crooked Creek	Missouri, USA	N 37°50'	W 91°23'	7	Early Ordovician to pre-Pennsylvanian			**485–323**	Snyder and Gerdemann (1965)	
Decorah	Iowa, USA	N 43°19'	W 91°46'	5.5	Middle Ordovician (Darriwilian Dw1–Dw2 interval) early post-impact Winneshiek Shale			**~467–464**	French et al. (2018) Bergström et al. (2018)	
East Clearwater Lake	Québec, Canada	N 56°05'	W 74°07'	22		Ar-Ar (impact melt rock)		**470–460**	Bottomley et al. (1990) Schmieder et al. (2015)	
Glasford	Illinois, USA	N 40°36'	W 89°47'	4	Late Ordovician (Sandbian)			**~455 ± 2**	Buschbach and Ryan (1963) Monson et al. (2019)	
Glover Bluff	Wisconsin, USA	N 43°58'	W 89°32'	10	Early Ordovician or younger			**<485**	Read (1983)	
Granby	Sweden	N 58°25'	E 14°56'	3	Lower *C. regnelli* zone (=lower Darriwilian) (chitinozoans)			**~466**	Grahn et al. (1996) Alwmark (2009)	
Hummeln	Sweden	N 57°22'04"	E 16°14'56"	1.2	Upper *C. regnelli* zone (=lower Darriwilian) (chitinozoans)			**~465**	Grahn et al. (1996) Alwmark et al. (2015)	
Ilyinets	Ukraine	N 49°08'	E 29°11'	4.5		Ar-Ar (impact melt breccia)		**445 ± 10**	Pesonen et al. (2004)	

Kärdla	Estonia	N 58°59'	E 22°40'	4	Transition *A. curvata* / *L. dalbyensis*zone (=late Sandbian), likely slightly older than Lockne			**455 ± 1**	Grahn et al. (1996)	
Lac Couture	Québec, Canada	N 60°08'	W 75°20'	8		Ar-Ar (impact melt rock)		**429 ± 25**	Bottomley et al. (1990), recalculated	425 ± 25
Lawn Hill	Queensland, Australia	S 18°40'	E 138°39'	18		Ar-Ar (impact melt breccia)		**476 ± 8**	Darlington et al. (2016), recalculated	472 ± 8
La Moinerie	Québec, Canada	N 57°26'	W 66°37'	8	Ordovician, pre-Silurian	U-Pb (LA-ICP-MS on apatite)		**453 ± 5**	Grieve (2006) McGregor et al. (2019)	
Lockne	Sweden	N 63°00'	E 14°48'	7.5 (~14)	Lower *L. dalbyensis* zone (=late Sandbian), likely slightly younger than Kärdla			**455 ± 1**	Grahn et al. (1996) Grahn (1997) Ormö et al. (2014)	
Lumparn	Finland	N 60°08'20"	E 20°07'30"	10	Middle Ordovician (Caradocian) or younger			**≤458**	Merrill (1980) Abels (2003)	
Målingen	Sweden	N 62°55'	E 14°33.84'	0.7	Lower *L. dalbyensis* zone (=late Sandbian), contemporary with Lockne			**455 ± 1**	Ormö et al. (2014)	
Mizarai	Lithuania	N 54°00'	E 23°54'	5	Late Cambrian to Early Ordovician			**~520–480**	Masaitis (1999) Abels et al. (2002)	
Newporte	North Dakota, USA	N 48°58'	W 101°58'	3	Late Cambrian – Early Ordovician			**~500–480**	Koeberl and Reimold (1995)	
Pilot	Northwest Territories, Canada	N 60°17'	W 111°01'	6		Ar-Ar (impact melt rock)		**450 ± 2**	Bottomley et al. (1990), recalculated	445 ± 2
Rock Elm	Wisconsin, USA	N 44°43'	W 92°14'	6	Early – Middle Ordovician			**~485–458**	Cordua (1985) French et al. (2004)	
Slate Islands	Ontario, Canada	N 48°40'	W 87°00'	30		Ar-Ar (impact melt rock)		**~450**	Sharpton et al. (1997) Grieve (2006)	
Tunnunik (Prince Albert)	Northwest Territories, Canada	N 72°27'	W 113°54'	25			Paleomagnetic age	**~450–430**	Lepaulard et al. (2019)	
Tvären	Sweden	N 58°46'	E 17°25'	2	*L. stentor* zone (=early Sandbian)			**~458**	Ormö (1994) Grahn et al. (1996)	
Osmussaar Breccia*	Estonia	N 59°17'	E 23°24'	n/a	Middle Ordovician (early Darriwilian)		Source crater unknown	**~466**	Suuroja et al. (2003) Alwmark et al. (2010)	

Table DR2: Summary of proposed impact structures of enigmatic origin and of proven and likely Ordovician age. Modified after Schmieder et al. (2015). Stratigraphic ages were taken from Cohen et al. (2013, updated).

Proposed structure	**Country**	**Latitude**	**Longitude**	**Diameter (km)**	**Stratigraphic age constraints**	**Reported age (Ma)**	**Age reference**
Banat Baqar	Saudi Arabia	N 29°07'	E 37°36'	12	Middle Ordovician	**~470– 458**	Neville et al. (2014)
Bouscaren	Texas, USA	N 31°01'	W 102°00'	1.3	Late Cambrian – Early Ordovician	**~500–470**	Maione (2015)
Dycus	Tennessee, USA	N 36°22'	W 85°45'	1.2	Ordovician	**~470–443**	Mitchum (1951) O'Connell (1965)
Howell	Tennessee, USA	N 35°14'	W 86°36'	1.5	Ordovician	**~470–443**	Born and Wilson (1939)
Ingalls	Oklahoma, USA	N 36°06'	W 96°53'	2	Ordovician	**~470–443**	Herrmann and Mayne (2011)
Jalamid	Saudi Arabia	N 31°27'	E 39°35'	19	Early Ordovician	**485–470**	Neville et al. (2014)
Jeptha Knob	Kentucky, USA	N 38°10'	W 85°07'	4.3	Late Ordovician or older	**>443**	Seeger (1968)
Peerless	Montana, USA	N 48°45'	W 105°50'	6	Late Ordovician	**~450–430**	Comstock et al. (2004)
Versailles	Kentucky, USA	N 38°05'	W 84°41'	1.6	Late Ordovician	**~458–443**	Black (1964)