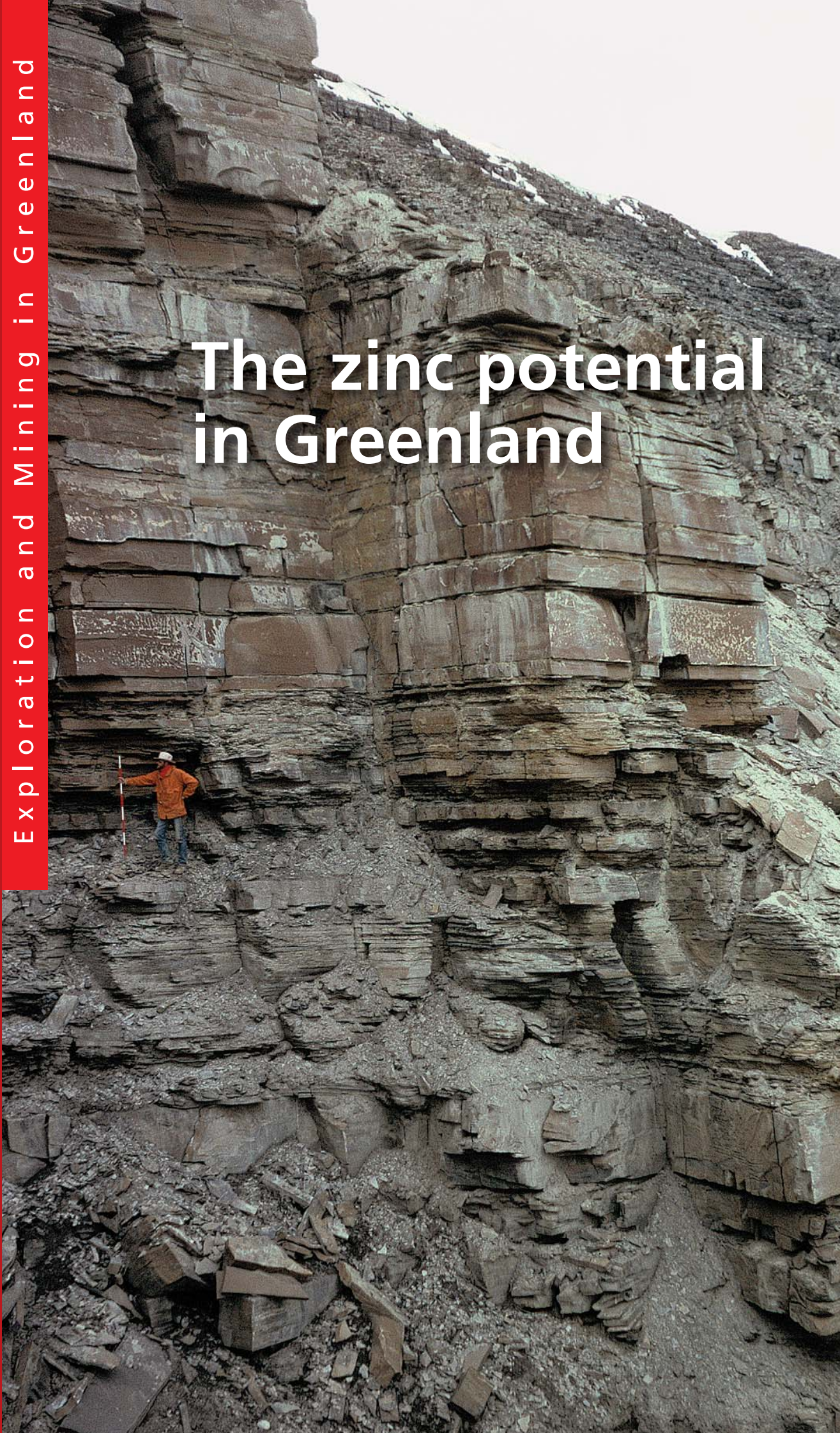


GEOLOGY AND ORE



Exploration and Mining in Greenland

The zinc potential in Greenland



The zinc potential in Greenland

- Assessment of undiscovered sediment-hosted zinc deposits



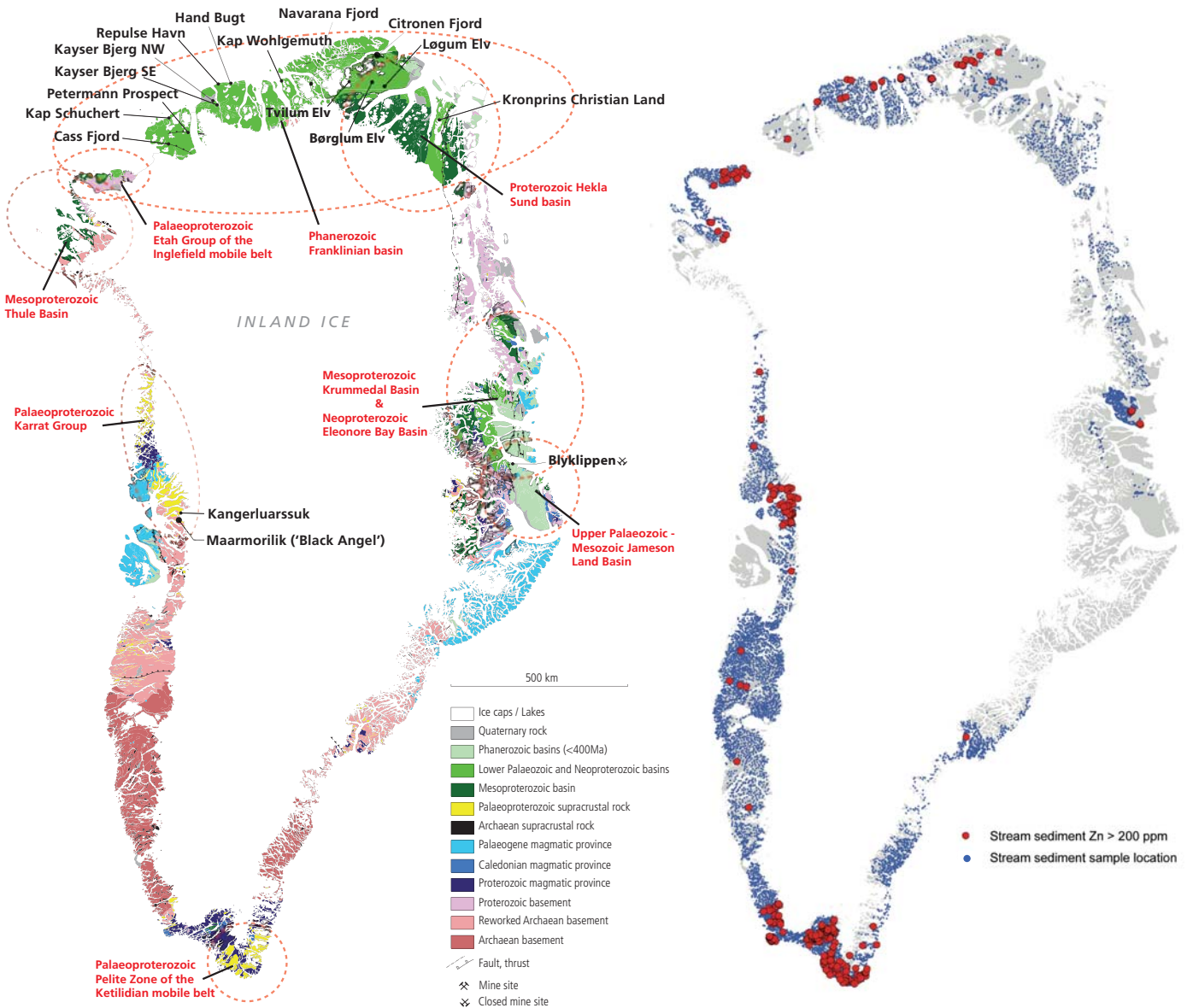
Zinc showings and occurrences are numerous in Greenland. In particular, the Palaeozoic Franklinian Basin, North Greenland, which extends for more than 2,500 km E-W through the Canadian Arctic Islands and northern Greenland, is considered to carry a large potential for hosting undiscovered zinc deposits. Until now Palaeoproterozoic sedimentary rocks have been the most important Greenlandic zinc source, namely the Black Angel

mine. However, zinc is also known from several occurrences in the Archaean, and the Meso- to Neoproterozoic and Phanerozoic sedimentary environments of West and East Greenland.

Introduction

A workshop on the 'Assessment of the zinc potential in Greenland' was arranged by the Geological Survey of Denmark and Greenland (GEUS) and the Ministry of

Mineral Resources (previously Bureau of Minerals and Petroleum) in 2011. The purpose of the workshop was to assess the possible presence of undiscovered zinc deposits in Greenland in the top 1 km of the Earth's crust and to rank the most prospective areas. The procedures for the assessment and ranking of the individual tracts were designed to comply, as much as possible, with the 'Global Mineral Resource Assessment Project' (GMRAP) procedures defined by the U.S. Geological



Survey (USGS). One further objective of the workshop is to stimulate new exploration campaigns in Greenland.

This issue of *Geology & Ore* highlights some of the results from the workshop, including descriptions of the most important sedimentary provinces in Greenland, their known zinc deposits/occurrences, and the resulting potential for undiscovered zinc deposits within these provinces. A more comprehensive description of the results from this workshop is included in Sørensen et al (2013). More recent data and information derived from reconnaissance field work carried out in the Eastern part of the Franklinian Basin, in 2012 and 2013, are also presented.

The methodology applied

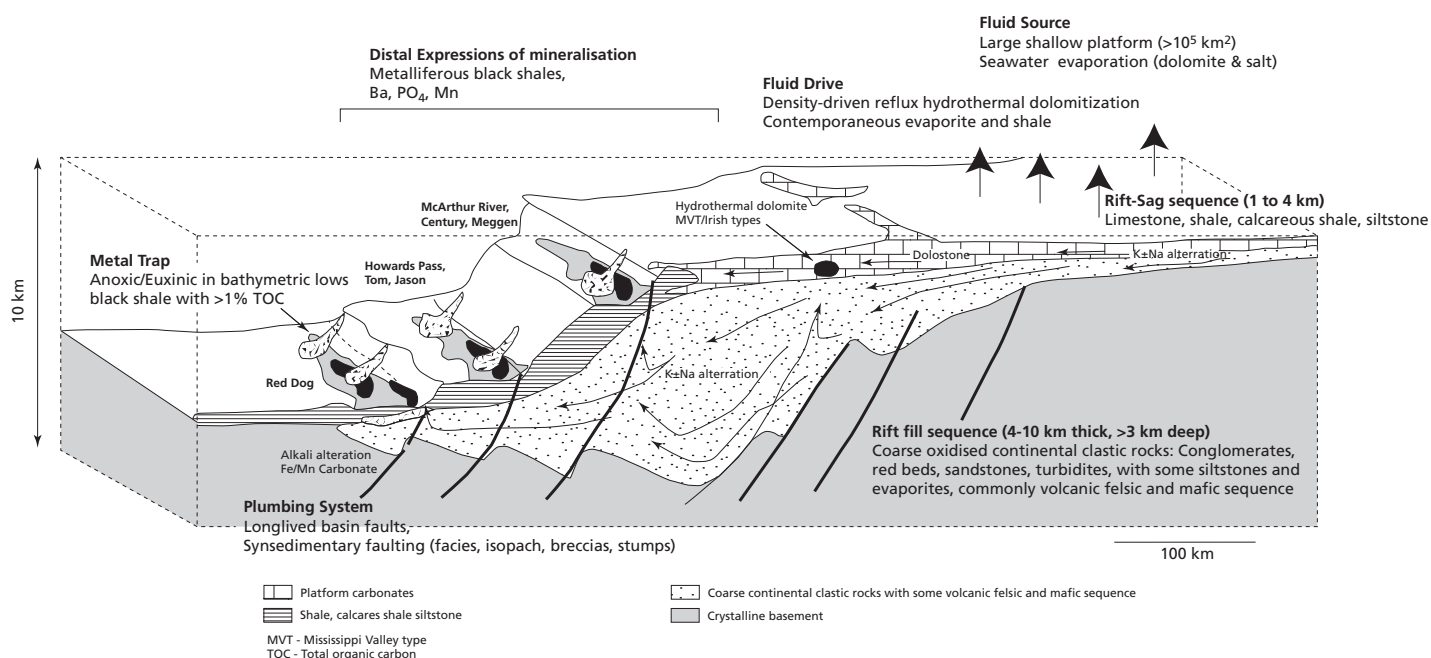
The evaluation of the potential for undiscovered sediment-hosted zinc deposits in

Greenland was carried out according to the standardised process utilised in the GMRAP. In this process, an assessment panel of experts discuss all available knowledge and data for a specific area (tract), and assess the possibility of finding new undiscovered deposits within this tract. The assessment panel constituted thirteen geologists from the USGS, GEUS, the Ministry of Mineral Resources (MMR), and private exploration companies, each with specific knowledge on aspects of Greenlandic geology and/or expertise in sediment-hosted zinc deposits. Each tract was defined from the surface to 1 km depth. The members of the assessment team made their individual estimates (bids) of the number of deposits of a specific size and grade they believe can be found and mined in a specific tract, under the best circumstances. A panel discussion of the bids led to a consensus bid, which was used as input to a statistical simulation. The result was a

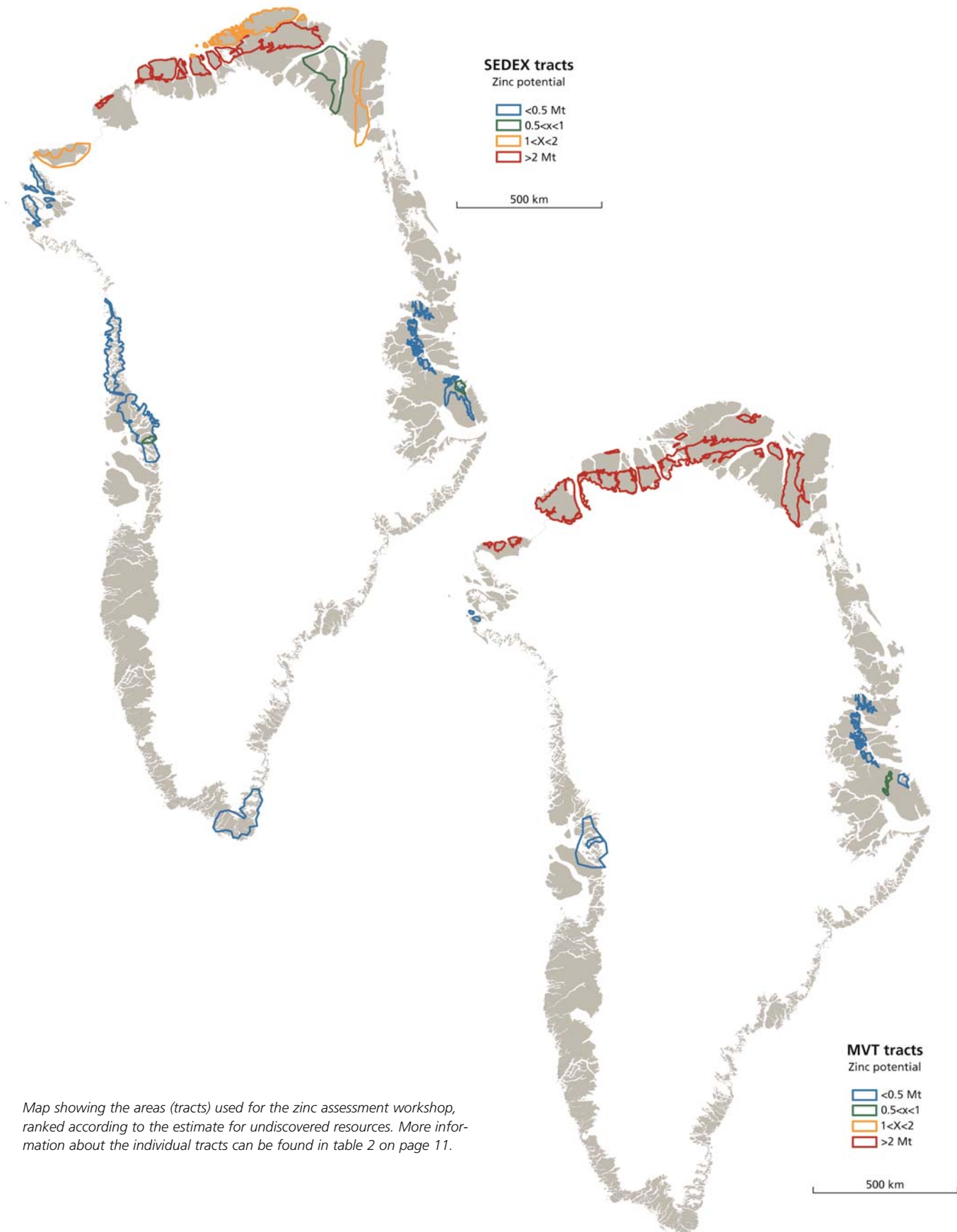
grade-tonnage estimate (prediction) of how much undiscovered ore and metal that can be found within a tract. The consensus bids and predicted number of undiscovered zinc deposits per tract are shown in table 2 on page 11, and the estimate of undiscovered zinc resources is displayed on the map of page 4.

Covered zinc deposit types

Globally, the most important zinc deposits are hosted in clastic-dominated sedimentary rock sequences, e.g. the sedimentary exhalative (SEDEX) deposits, and carbonate-hosted zinc deposits, known as Mississippi Valley-Type (MVT). Sediment-hosted zinc deposits account for approximately 43% (SEDEX 38.4% and MVT 4.2%) of the world's zinc production and known reserves. They are also important sources of Pb, Ag and Ba.



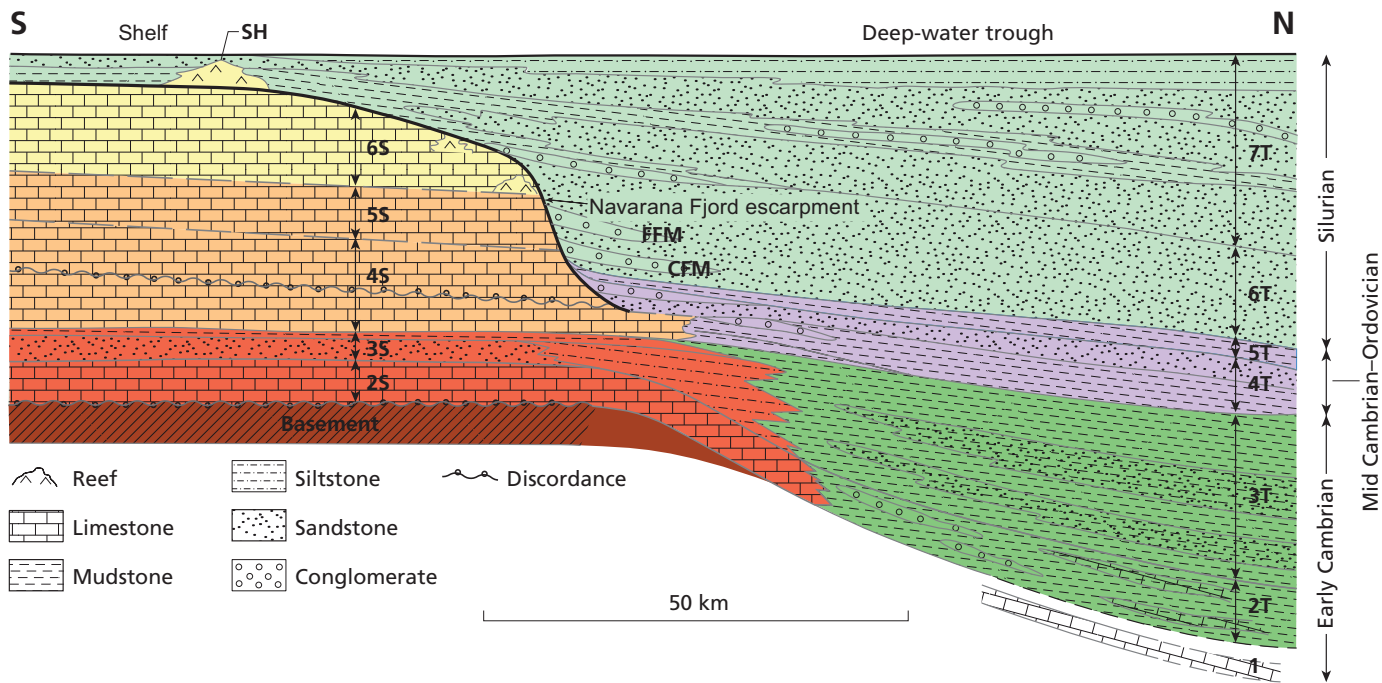
Conceptual model of the geologic setting and geologic assessment criteria for SEDEX and MVT Zn-Pb-Ag deposits modified from Emsbo (2009). Grey arrows represent fluid-flow paths inferred from the distribution of altered rocks and a 2009 USGS numerical fluid-flow-modelling project. The locations of several important SEDEX deposits relative to the shallow-water platform margin are indicated and may reflect the structural architecture of the basin or the maturity of the rift cycle.



Map showing the areas (tracts) used for the zinc assessment workshop, ranked according to the estimate for undiscovered resources. More information about the individual tracts can be found in table 2 on page 11.



Tight folds in a moderately folded part of the North Greenland fold belt. The sequence comprises dark, fine-grained slates and greyish sandstones from the Ordovician and Lower Silurian that were deposited in the Franklinian Basin. Locality is in northern Nares Land, North Greenland. The mountainside is about 350 m high.



South–north cross-section of the Franklinian Basin showing the transition from shallow-water carbonate shelf to deep-water, sand- and silt-dominated deposits in the trough, with colours highlighting different depositional stages. The succession is continuous from the earliest Cambrian (542 Ma) to the earliest Devonian (about 410 Ma). The shallow-water sediments of the carbonate shelf pass northwards into a much thicker sequence of clastic, deep-water sediments. The boundary between the shelf and the deep-water trough is a steep escarpment. In the Silurian, deposition of the turbiditic sediments was very rapid, the trough was filled, and turbidites spread out over the shelf areas. The development of the basin can be divided into 7 stages (see figure on page 7); S indicates shelf deposits and T trough deposits. Sediment thickness on the shelf was 3–4 km and in the trough about 8 km. The profile is drawn with a vertical exaggeration. From Henriksen (2008).

SEDEX deposits

SEDEX deposits are finely laminated or bedded sulphide ore deposits, interpreted to have formed by release of ore-bearing hydrothermal fluids into a water reservoir, usually the ocean, resulting in the precipitation of stratiform ore. SEDEX deposits are hosted in rift-generated intracratonic or epicratonic sedimentary basins, often related to a nearby carbonate platform. Deposits occur in carbonaceous shales in basin sag-phase carbonate rock, shale or siltstone facies mosaics that were deposited on thick sequences of rift-fill conglomerates, red beds, sandstones or siltstones and mafic or felsic volcanic rocks (see conceptual model on page 3).

SEDEX deposits are the most important sources of zinc, and they are typically associated with lead and barite mineralisation. It is common for multiple SEDEX deposits to be distributed over many tens of kilometres along basin-controlling

faults. Thus, areas along large fault systems with evidence of mineralisation are viewed as very favourable for deposits (Emsbo, 2009).

MVT deposits

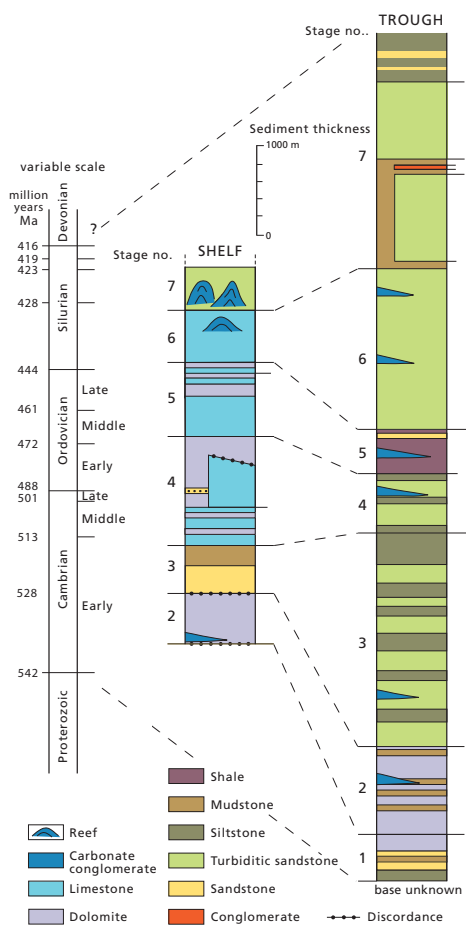
MVT ore deposits have valuable concentrations of zinc sulphide ore hosted in carbonate (limestone, marl and dolomite) formations. The most important ore controls are faults and fractures, dissolution collapse breccias and lithological transitions. Most MVT deposits are hosted in Phanerozoic rocks, and are significantly less common in Proterozoic rocks. MVT ores are located in carbonate platform sequences in passive margin environments, and are commonly related to extensional domains landwards of contractional tectonic belts (see conceptual model below). The ore bodies range from 0.5 to 20 Mt or more of contained ore, and have grades of between approximately 3% and 12% zinc. MVT deposits

usually occur in extensive districts consisting of several to hundreds of deposits (Leach et al., 2010).

Sedimentary environments in Greenland

During the Proterozoic and throughout the Palaeozoic and Mesozoic, major intercontinental-rift-related sedimentary basins and successions formed in West, North and East Greenland, with sedimentary successions reaching up to 18 km in thickness. The major sedimentary successions are:

- (i) Palaeoproterozoic Karrat Group in West Greenland;
- (ii) Mesoproterozoic Thule Basin in North-Western Greenland;
- (iii) Palaeoproterozoic Etah Group of the Inglefield mobile belt in western North Greenland;
- (iv) Phanerozoic Franklinian basin in North Greenland;



Composite sedimentary logs of the Franklinian Basin succession in North Greenland, showing the carbonate-shelf and corresponding deep-water trough developments. From Henriksen (2008).

- (v) Proterozoic Hekla Sund Basin, eastern North Greenland;
- (vi) Mesoproterozoic Krummedal Basin, Central East Greenland;
- (vii) Neoproterozoic Eleonore Bay Basin in Central East Greenland;
- (viii) Upper Palaeozoic - Mesozoic Jameson Land Basin, Central East Greenland;
- (ix) Palaeoproterozoic Pelite Zone of the Ketilidian Orogen in South Greenland.

Sedimentary zinc occurrences have been identified in nearly all of the above sedimentary environments, and the geological settings of the most important environments for sediment-hosted zinc deposits are described in the following:

Karrat Group

The Palaeoproterozoic supracrustal rocks, known as the Karrat Group, extends north-south for a distance of approximately 550 km in North West Greenland, covering approximately 10,000 km². The Group rests unconformably on an Archaean gneiss complex and consists of a very thick sedimentary package. The Karrat Group was deposited in a very large subsiding epicontinental basin, suggested to represent a Palaeoproterozoic passive margin sequence. It is estimated that the deposition of the last basinal facies took place around 2 Gyr ago. The Karrat Group is divided into a lower and upper Karrat Group, called the Qeqertarsuaq and the Nûkavsak Formations, respectively. The Qeqertarsuaq Formation is mostly composed of pelite and quartzite, whereas the top of the formation is characterized by an amphibolite layer interpreted to be volcanogenic. The maximum thickness of the formation is 3,000 m on the north side of Kangigdleq, but thins abruptly in all directions, to only 140 m thickness 20 km to the south-east. The Marmorilik Formation, comprising carbonate units totalling at least 1,600 m in thickness, is interpreted to be the lateral equivalent to the Qeqertarsuaq Formation, deposited to the south in a separate basin. The Nûkavsak Formation is more than 5,000 m thick and exposed over large areas. It consists of uniform, coarse-grained to fine-grained clastic sediments, originally deposited as turbidites. The Archaean basement and the Karrat Group were deformed and metamorphosed before they were intruded by the large Prøven Igneous Complex. The Karrat Group can be correlated to the Foxe Belt of North East Canada. The basement and the cover sequence were subjected to several phases of strong folding and thrusting during the Nagsugtoqidian-Rinkian orogenesis, and where variably affected by regional metamorphism.

The Inglefield mobile belt

Inglefield Land is situated in Western North Greenland. The basement consists of Palaeoproterozoic juvenile para- and orthogneisses representing high-grade

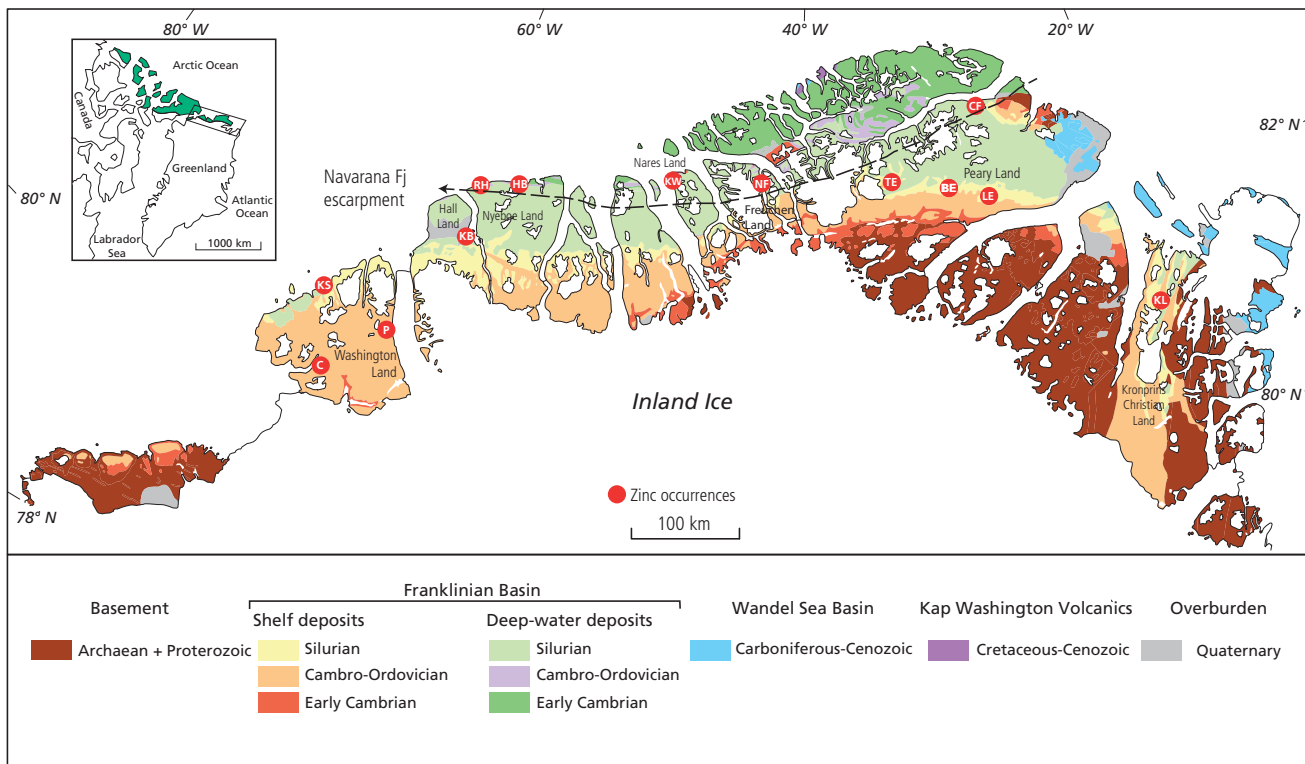
supracrustal and granitoid rocks. The supracrustal rocks, called the Etah Group, are believed to be the oldest rocks in the area, and consist of garnet-rich paragneiss, calc-silicate gneiss, marble-dominated units, amphibolite, ultramafic rock and quartzite. The supracrustal sequence is intruded by the Etah meta-igneous complex, which is composed of intermediate to felsic meta-igneous rocks, metagabbros and orthogneisses. The Etah Group and the Etah meta-igneous complex were metamorphosed at 1920 Ma under low-pressure to medium-pressure granulite facies conditions, coinciding with at least three phases of deformation. The Mesoproterozoic Thule Supergroup and the Cambrian deposits of the Franklinian Basin overlie the Palaeoproterozoic sequence. The Inglefield Mobile Belt is interpreted as a Palaeoproterozoic arc, formed by convergence of two Archaean crustal blocks.

The rock sequences of the Inglefield Mobile Belt can be correlated across the Nares Strait to northern Baffin Bay and into mainland Canada, without offset.

Franklinian Basin

The largest sedimentary basin in Greenland, the Palaeozoic Franklinian Basin, extends East West for more than 2,500 km in northern Greenland and Canada. Deposition in the Franklinian Basin took place along a passive continental margin and began in the latest Precambrian and continued until at least earliest Devonian.

The sediments were deposited unconformably on Proterozoic sandstones and shales, and Archaean crystalline basement rocks. The sedimentary succession is several kilometres thick, and developed into three different sedimentary environments; (1) a southern broad, shallow-water, dominantly carbonate shelf nearest the continent, bordered to the north by a slope with moderate- to deep-water depths environments and (2) a broad outer shelf deep-water trough environment in which a thick flysch succession accumulated (3). The shelf succession is dominated by carbonates and reaches 4 km in thickness.



Distribution of Zn occurrences in North Greenland: BE-Børglum Elv; CF-Citronen Fj; C-Cass Fj; HB-Hand Bugt; KB-Kayser Bjerg; KL-Kronprins Christian Land; KS-Kap Schuchert; KW-Kap Wohlgemuth; LE-Løgum Elv; NF-Navarana Fj; P-Petermann; RH-Repulse Havn; TE-Tvillum Elv (modified after Rosa et al., 2016).



The shelf-trough sediments are dominated by siliciclastic rocks, including turbiditic siltstones and sandstones, terrigenous mudstones and shales, and have a total thickness of approximately 8 km.

The shelf-trough boundary was controlled by deep-seated faults, such as the pronounced Navarana Fjord escarpment, which, with time, expanded southwards to new fault lines, with final foundering of the shelf areas in the Silurian. The boundary between the platform and shelf sedimentary regimes fluctuated considerably; in some periods the platform was almost drowned, while in other periods the platform prograded, and the platform margin coincided with the shelf-slope break. The evolution of the Franklinian Basin has been divided into seven stages with significant changes in regime linked to southward expansion of the basin margin. The northern parts of the basin deposits were

Drill core from Citronen Fjord with fine-grained laminated sulphides in black mudstone. The sulphide laminae consist of framboidal pyrite in a matrix of sphalerite and carbonate. Zn-content in the upper sulphide layer is 25–30% and in the lower layer 1–3%. The core is 3.6 cm across.

deformed in Devonian to Carboniferous time during the Ellesmerian Orogeny with a resulting development of a thin-skinned fold and thrust zone fold belt in the south. A later deformational event affected the northernmost part of the sequence late in the Cretaceous. For a more comprehensive description of the geological setting of the Franklinian Basin please refer to Peel & Sønderholm (1991).

Hekla Sund and Eleonore Bay Basins

Two major Neoproterozoic sedimentary basins that probably formed in response to an early pulse of lapetan rifting along the Laurentian margin are well exposed in East Greenland. The Hekla Sund Basin is exposed at the northern termination of the East Greenland Caledonides, and it is represented by the Rivieradal and Hagen Fjord Groups, which attain a cumulative thickness of 8-11 km. The evolution of this basin reflects deposition during active rifting and a post rift thermal equilibration stage. A comparison with other Neoproterozoic basins along the Laurentian margin of the Iapetus Ocean shows similarities between the Hekla Sund Basin and coeval deposits on Svalbard and the Central Highlands of Scotland.

The Eleonore Bay Basin of East Greenland comprises a more than 14 km thick succession of shallow-water sedimentary rocks. Four stages of basin evolution are recognised; three stages reflect shelf environments that are terminated by a change to shallow-marine siliciclastic to carbonate-platform deposition environment.

Jameson Land Basin

The Jameson Land Basin covers approximately 13,000 km² and comprises a stratigraphically almost complete and well exposed succession of Upper Palaeozoic-Mesozoic sediments. The composite thickness of the package is more than 17 km, with the lower approximately 13 km consisting of continental clastics deposited during Middle Devonian - Early Permian rifting. In latest Palaeozoic and Mesozoic time, the basin was dominated by regional subsidence due to thermal contraction and more than 4 km of sediments accumulated. The Upper Permian Foldvik Creek Group rests with angular unconformity on Devonian to Lower Permian continental clastic sediments, being overlain conformably by Triassic to Cretaceous, mainly marine clastic sediments. Paleogene Tertiary igneous rocks intrude this succession. The approximately 300 m thick Upper Permian sequence comprises a basal conglomerate, marginal marine evaporites and carbonates (Karstryggen and Wegener Halvø Formations), bituminous shale and a shallow marine clastic unit. Stratabound copper-lead-zinc-barite and celestite occurrences are common in the Upper Permian and Triassic sediments.

Known sediment-hosted zinc occurrences

With the exception of the Karrat Group that hosts the Black Angel zinc-lead mine in Central West Greenland, the Citronen Fjord deposit in North Greenland, and the former Blyklippen mine in East Greenland, very limited exploration for zinc has been carried out in Greenland, and only a few occurrences have been investigated in enough detail to allow estimates of overall tonnage and grade. A table of known zinc occurrences in Greenland is found above.

Selected known Zinc occurrences

Class	Locality name	Type
Closed mine	Black Angel/Maarmorilik	carbonate-hosted Pb, Zn
Closed mine	Blyklippen, East Greenland	vein-hosted Pb-Zn
Deposit	Citronen Fjord, Peary Land	shale-hosted Zn, Pb
Prospect	Cass Fjord, Washington Land	carbonate-hosted Zn, Pb, Ba
Prospect	Kangerluarsuk, Central West Greenland	carbonate-hosted Pb, Zn
Prospect	Petermann Prospect, Washington Land	carbonate-hosted Zn, Pb, Ag
Showing	Børglum Elv, Peary Land	carbonate-hosted Pb, Zn
Showing	Hand Bugt, Nyboe Land	stratabound Zn, Pb, Ba
Showing	Kronprins Christian Land	carbonate-hosted Pb, Zn
Showing	Kayser Bjerg NW, Hall Land	carbonate-hosted Zn, Pb
Showing	Kayser Bjerg SE, Hall Land	carbonate-hosted Zn, Pb
Showing	Kap Schuchert, Washington Land	carbonate-hosted Pb, Zn
Showing	Kap Wohlgemuth, Nares Land	stratabound Zn, Pb, Ba
Showing	Løgum Elv, Peary Land	carbonate-hosted Pb, Zn
Showing	Navarana Fjord, Barite zone	calcite vein hosted Ba
Showing	Navarana Fjord, Freuchen Land	stratabound Zn, Pb, Ba
Showing	Navarana Fjord, Lauge Koch Land	stratabound Zn, Pb, Ba
Showing	Navarana Fjord, Sulphide zone	calcite vein hosted Zn, Ba
Showing	Repulse Havn, Nyboe Land	stratabound Zn, Pb, Ba
Showing	Tvilum Elv, Peary Land	carbonate-hosted Pb, Zn

Table of selected zinc prospects, showings and mines in Greenland. Information is extracted from the GEUS-MMR mineral occurrence database. The individual occurrences are shown on map page 2.

In North Greenland, the Palaeozoic Franklinian Basin is recognised to host several zinc occurrences, including the Citronen Fjord Zn-Pb deposit. The Citronen Fjord deposit occurs within the deep-water clastic trough sediments of the basin. The global resource estimate of the Citronen deposit is 70.8 Mt at 5.2% Zn and 0.5% Pb at a 3.5% Zn cut-off. The mineralisation is hosted at three levels within a 200 m thick sequence of Ordovician black shales and chert.

The shallow-water platform, shelf and slope facies of the Franklinian Basin are also known to host several, mainly carbonate-hosted zinc occurrences, such as the Petermann Prospect and the Cass Prospect, both in Washington Land, and the occurrences at Kayser Bjerg, Hall Land, and in the vicinity of Navarana Fjord; none of these have been investigated in detail. The four easternmost showings (at Tvilum Elv, Børglum Elv, Løgum Elv, Kronprins Christian Land), described by Rosa et al. (2014), have been dated and interpreted to be related to brines circulating in the foreland of the developing Ellesmerian Orogen (Rosa et al., 2016). The facies-border and structures that most likely have a guiding control on the mineralising systems within

the basin in North Greenland can be observed for several hundred kilometres and may represent an excellent target for Zn-Pb exploration.

In North West Greenland, sediment-hosted zinc occurrences are known within the Karrat Group, hosted within marbles, pelites and cherts, and these occur intermittently over a strike length of approximately 9 km. The best outcrop so far located is a 15–35 cm thick horizon of massive, dark brown sphalerite assaying 41% Zn. The Karrat Group also hosts a great number of carbonate-hosted Zn-Pb mineralisations, particularly within the Marmorilik Formation. The most famous is the Black Angel Mine, which comprises several ore bodies, totalling 13.6 Mt at 12.3% Zn, 4.0% Pb and 29 ppm Ag. When the mine was closed in 1990 approximately 2 Mt of ore were left behind, mainly in the pillars. It has been debated whether the deposit represents SEDEX or later stage MVT processes. The other known Zn-Pb mineralisations within the same stratigraphical settings remain to be investigated in further detail. New occurrences have recently been found in grounds formerly covered by the Inland Ice.

Part of the Lower and Middle Cambrian sequence in the south-western corner of Peary Land. The easily weathered grey-black shales and sandstones of the Buen Formation (stage 3) are overlain by a prominent crag of banded limestones from the Brønlund Fjord Group (stage 4, shelf facies). The mountain is about 800 m high.



Consensus bids on the number of undiscovered zinc deposits per area (tract)

Mineralisation Model	Region	Area	Tract name	Areal extent	Number of undiscovered zinc deposits on different confidence levels				
					N90	N50	N10	N05	N01
SEDEX	North Greenland	Ordovician, Franklinian Basin, Amundsen Land Group	SHam_NG_15	184	1	1	2	3	4
			SHam_NG_16	655	0	1	2	2	4
		Silurian, Franklinian Basin, Trough Sequence	SHam_NG_3	30,060	1	2	3	5	10
			MLme_NG_1	12,780	0	0	2	4	5
	West Greenland	Palaeoproterozoic, Karrat Group, Nukavsak Formation	SHme_WG1	9,606	0	0	0	0	2
			SHme_WG2	12,650	0	0	0	1	2
			SHme_WG3	606	0	0	1	1	1
	North West Greenland	Palaeoproterozoic, Inglefield mobile belt, Etah Group	MLme_NW_IG_1	6,464	0	0	1	2	5
			MLme_NW_1	4,325	0	0	0	1	4
	North East Greenland	Neoproterozoic, Hagen Fjord Group	MLme_NE_HF_1	12,966	0	0	1	2	3
			MLme_NE_RG_1	7,346	0	0	1	2	4
	Central East Greenland	Neoproterozoic, Eleonore Bay Supergroup	MLme_EBS_1	3,069	0	0	0	1	3
Triassic, Fleming Fjord & Pingodal Formation			SHam_T_EG_1	3,258	0	0	0	1	2
Upper Permian, Foldvik Creek Group, Ravnefjeld Fm			MLam_P_EG_1	863	0	0	1	2	3
Upper Permian, Foldvik Creek Group			MLam_P_EG_2	616	Assessed - but no voting				
South Greenland	Palaeoproterozoic, Ketilidian Pelite zone	SHme_S_1	1,065	0	0	0	0	2	
MVT	North Greenland	Silurian, Franklinian Basin, Carbonate shelf-platform	CAam_NG_1	51,738	1	3	4	5	8
	North West Greenland	Meso - Neoproterozoic, Thule Supergroup	CAme_NW_1	351	0	0	0	1	3
	West Greenland	Palaeoproterozoic, Karrat Group, Marmorilik Fm	CAme_WG_1	10,585	0	0	0	0	1
			CAme_WG_2	749	0	0	1	1	1
	North East Greenland	Neoproterozoic - Eleonore Bay Supergroup	MLme_EBS_1MVT	3,069	0	0	0	1	4
	Central East Greenland	Upper Permian, Foldvik Creek Group	MLam_P_EG_1M	863	0	0	1	2	3
			Upper Permian, Foldvik Creek Group, Karstryggen	MLam_P_EG_2M	616	0	1	1	2

*N90, N50, N10, N05, N01 = Confidence levels; a measure of how reliable a statistical result is, expressed as a percentage that indicates the probability of the result being correct. A confidence level of 10% (N10) means that there is a probability of 10% that the result is reliable.

Table 2. Consensus bids on the number of undiscovered zinc deposits per area (tract) from the 2011 zinc mineral resource assessment workshop.

In central East Greenland, within the Jameson Land Basin, sediment-hosted zinc deposits are known from both Upper Permian and Upper Triassic strata. The zinc mineralisation within the black shales of the Ravnefjeld Formation is widespread and has been compared with the European Kupferschiefer type.

Potential areas for undiscovered zinc deposits

At the workshop the assessment team gave their individual bids at different confidence levels, on how many zinc deposits they thought could be discovered under the best circumstances. The consensus bids and number of undiscovered zinc deposits per tract are shown in Table 2, and the estimate of undiscovered zinc resources is displayed on the map of page 4. The distribution of estimated undiscovered zinc deposits over the different confidence levels, as well as the increase in numbers from one confidence level to another, reflect the level of knowledge about the various areas and the overall assessment of the potential and prospectivity within the areas.

The assessment panel agreed that the largest potential for large grade-tonnage deposits of the SEDEX zinc type was within the trough sequences of (i) the Franklinian Basin in North Greenland, (ii) the Inglefield mobile belt in western North Greenland, (iii) the Rivieradal Group in the Hekla Sund Basin in eastern North Greenland, and (iv) the Foldvik Creek successions in the Jameson Land Basin.

The biggest potential for MVT-type zinc deposits was agreed to be within (i) the carbonate shelf-platform of the Franklinian Basin in North Greenland, (ii) the Foldvik Creek successions in the Jameson Land Basin and (iii) the Marmorilik Formation of the Karrat Group in West Greenland.

For further discussion and comments to the different areas and potential, please refer to the more comprehensive GEUS survey report documenting the results from the workshop (Sørensen et al., 2013). A North Greenland datapackage is available for download at www.greenmin.gl.

Concluding remarks

Greenland has operated one of the largest Zn-Pb mines in Europe, the Black Angel mine, and is generally endowed with thick sedimentary successions that genetically match the criteria for formation of Pb-Zn deposits. Most of the sedimentary successions are under- or unexplored, but are considered favourable targets and hold evidence of the mineralising processes needed to form a zinc deposit. Of particular interest in terms of potentially undiscovered SEDEX type Pb-Zn deposits are the under-explored parts of the sedimentary sequences of the Franklinian Basin in North Greenland, which hosts the large Citronen Fjord zinc deposit, the Inglefield mobile belt in western North Greenland, the Rivieradal Group in eastern North Greenland and the Foldvik Creek group in Central East Greenland. For the MVT-type zinc deposits, the carbonate platform of the Franklinian Basin in North Greenland, the Marmorilik Formation of the Karrat group in West Greenland and the Foldvik Creek group in Central East Greenland are considered to have good potential for undiscovered deposits.



Cliff section at the head of Navarana Fjord showing the 1300 m high, submarine slope (escarpment) that formed the north edge of the Silurian shallow-water limestone shelf. The Navarana Fjord escarpment can be traced as a distinct geological lineament from eastern Peary Land westwards to Nyeboe Land, a distance of more than 500 km.

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Front cover photograph

Sandy and muddy turbiditic sediments, part of the fill of the Silurian deep-water trough in Peary Land. The sandy sediments occur at the base of each bed, and silt- and mud-dominated material form the upper parts of each graded unit. The thickness of each graded layer can vary between a few metres up to about 20 m.

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