40th ANNIVERSARY

THE Crafoord PRIZE

Crafoord *Days* 2022

25–27 APRIL IN LUND, SWEDEN

PHOTO: THE ROYAL SOCIETY

ANDREW H. KNOLL

The Crafoord *Prize* in Geosciences 2022

Abstracts and Programmes

Anna-Greta and Holger Crafoord Fund

THE FUND WAS ESTABLISHED in 1980 by a donation to the Royal Swedish Academy of Sciences from Anna-Greta and Holger Crafoord. The Crafoord Prize was awarded for the first time in 1982. The purpose of the fund is to promote basic scientific research worldwide in the following disciplines:

- Mathematics
- Astronomy
- Geosciences
- Biosciences (with particular emphasis on Ecology)
- Polyarthritis (e.g. rheumatoid arthritis)

Support to research takes the form of an international prize awarded annually to outstanding scientists and of research grants to individuals or institutions in Sweden. Both awards and grants are made according to the following order:

year 1: Mathematics and Astronomy
year 2: Geosciences
year 3: Biosciences (with particular emphasis on Ecology)
year 4: Mathematics and Astronomy
etc.

The Prize in Polyarthritis is awarded only when the Academy's Class for medical sciences has shown that scientific progress in this field has been such that an award is justified.

Part of the fund is reserved for appropriate research projects at the Academy's institutes. The Crafoord Prize presently amounts to 6 million Swedish krona.

The Crafoord Prize is awarded in partnership between the Royal Swedish Academy of Sciences and the Crafoord Foundation in Lund. The Academy is responsible for selecting the Crafoord Laureates.

Content

PROGRAMMES

The Crafoord Laureate in Geosciences 2022

PHOTO: THE ROYAL SOCIETY

ANDREW H. KNOLL
HARVARD UNIVERSITY, CAMBRIDGE, USA

Andrew H. Knoll, Harvard University, Cambridge, USA, *"for fundamental contributions to our understanding of the first three billion years of life on Earth and life's interactions with the physical environment through time"*.

The Crafoord *Prize* in Geosciences

Studies of life's earliest history led to the Crafoord Prize

For billions of years, Earth was an inhospitable place with an atmosphere full of gases such as methane and ammonia. Life comprised unicellular organisms that primarily lived off the chemical energy found in their surroundings. Cyanobacteria that developed photosynthesis were decisive steps forward, as they used sunlight to transform carbon dioxide and water into biomass and free oxygen. Over time, a diversity of species arose and the world became a greener, more oxygen-rich place.

How did this actually occur, and how did life on Earth evolve over its first three billion years? These are the issues on which **Andrew H. Knoll** has provided fundamental insights. He has developed and combined methods for geological, biological and chemical analysis, which are now widely used by researchers around the globe. Using these methods, he has succeeded in determining the age of strata in bedrock and studied microscopically tiny fossils of unicellular and multicellular organisms from deep time.

"Andrew Knoll is an incredibly versatile researcher who has taught and inspired many younger researchers in his field, and those who have followed in his footsteps have further added to our knowledge of how life developed on Earth," says Stefan Bengtson, member of the Royal Swedish Academy of Sciences' Class for geosciences.

In addition, Andrew Knoll is one of the researchers who have presented a feasible explanation for the third mass extinction, which happened 252 million years ago. More than 90 per cent of all species in the oceans and 70 per cent of land animals disappeared. The proposed cause is volcanoes in Siberia that emitted huge amounts of carbon dioxide into the atmosphere, leading to toxic environments and an increase in the average temperature on Earth. He has also described how life returned after this disaster, in the form of many new plants and animals.

ABSTRACTS IN GEOSCIENCES

Crafoord *Days* 2022

Phytoplankton in space and time

CRAFOORD LAUREATE 2022 **ANDREW H. KNOLL**, HARVARD UNIVERSITY, CAMBRIDGE, USA

Ecosystems on Earth are built on a foundation of primary producers, with phytoplankton playing a principal role in supporting marine life. The geologic record suggests a temporal pattern of shifting ecological prominence in shelf and platform phytoplankton, beginning with photosynthetic bacteria, followed by green algae and culminating in the present day importance of dinoflagellates, coccolithophorids and diatoms. The first order similarity of this temporal pattern with the geographic distribution of phytoplankton in the modern ocean – a pattern related to nutrient availability – suggests that phytoplankton evolution may both reflect and contribute to Earth's long term environmental development.

In this lecture, I will explore the hypothesis that phosphorus bioavailability, related to the late Archean emergence of cratons, the Neoproterozoic emplacement of a modern P cycle in the oceans, and Mesozoic-Cenozoic orogenesis, helped to shape the observed geologic pattern of phytoplankton evolution. I will also argue that a better understanding of phytoplankton (and seaweed) evolution can illuminate the more commonly investigated history of marine animals. The overarching theme is that tectonics, redox conditions and biology are intimately intertwined and have been so since the Earth was young.

Pumping and swimming through time

NICHOLAS J. BUTTERFIELD, UNIVERSITY OF CAMBRIDGE, UK

All organisms interact physically with their environment, but only eukaryotes are capable of substantial propulsion – of themselves or of the medium in which they live. And even then, a capacity to pump water, or actively to swim through it, requires a collective, metazoan-grade of coordination. Once established, however, such behaviour had profound implications for the fate of primary productivity and the escalatory 'engineering' of marine environments – everything from the ventilation of bottom water by cilia-powered sponges to fertilization of the surface-ocean by muscle-powered whales. One of the most fundamental of these top-down effects is diurnal vertical migration (DVM), a phenomenon driven by visual predation in swimming animals and by far the largest systematic displacement of biomass on the planet. Significantly, the maximum depth of DVM in the modern oceans defines the top of oxygen minimum zones (OMZs). How then might the redox chemistry of the oceans have been expressed prior to the evolution of animals – and how will it have evolved alongside first-order shifts in the biomass and motility of predatory nekton? At the same time, increased *lateral* movement will have radically altered the connectivity and dynamics of marine food-webs, with yet further feedback effects on evolving diversity, stability and biogeochemical feedbacks. The end product of all this thrashing about is the fantastically interconnected system we know as the modern marine biosphere. It's a world away from the stratified microbial systems of the Proterozoic, but with a wake still visible in the fossil record.

A case for an active eukaryotic marine biosphere during the Proterozoic Era: Fossils meet models

DONALD E. CANFIELD, UNIVERSITY OF SOUTHERN DENMARK, ODENSE, DENMARK

Andy Knoll has pioneered our understanding of the evolution of eukaryotes and eukaryote ecosystem through time. Still, outstanding issues remain. Thus, while the microfossil record demonstrates the presence of eukaryotic protists in the marine ecosystem by about 1700 million years ago (Ma), steranes, a biomarker indicator of eukaryotic organisms, do not appear in the rock record until about 780 Ma in what is known the "Rise of Algae". This dichotomy is typically explained with the argument that eukaryotes were minor ecosystem members before 780 Ma, with prokaryotes dominating both primary production and ecosystem dynamics. With this view, the rise of algae was possibly sparked by increased nutrient availability stimulating the higher nutrient requirements of eukaryotic algae. In my talk, I will challenge this view. Thus, we have used a size-based ecosystem model to show that the size distribution of preserved eukaryotic microfossils from 1700 Ma and onwards required an active eukaryote ecosystem complete with phototrophy, osmotrophy, phagotrophy and mixotrophy. This result is robust over nutrient concentrations ranging over two orders of magnitude. Furthermore, model results suggest that such eukaryote ecosystems could have provided from one third to one half of the marine primary production. In this view, the general lack of steranes in the pre-780 Ma rock record could be a result of poor preservation.

Significance of microbes during mass extinction events and their role in exceptional fossil preservation

KLITI GRICE, CURTIN UNIVERSITY, PERTH, AUSTRALIA

The largest mass extinction 'event' of life (end-Permian) occurred when atmospheric O_2 levels were low & CO_2 & H_2S rising. In contrast to the meteor induced end-Cretaceous extinction event that wiped out non-avian dinosaurs, climate forces of the end-Permian event came from the aggregation of Pangea & its volcanism. Green sulfur bacteria (GSB) were globally plentiful in the Late Permian seas implying abundant H_2S, used by GSB in photosynthesis. Similar conditions have been invoked during all past global warming & biotic crises. However, recent molecular data showed conflated global C cycle disruptions for the end-Triassic extinction were related to an abrupt drop in relative sea level, & transition from marine to non-marine conditions with an emergence of microbial mats (MMs). The existence of MMs in the 'extinction zone' of the Chicxulub asteroid crater show that photosynthesis in the seas recovered within 200 kyrs. Detection of perylene (a fungal wood biomarker) in the crater tracked tsunami which flooded the crater within days after the impact – the first molecular days to week's resolution of a tsunami.

Some exceptionally preserved fossils inside concretions record preservation of soft tissues or articulated skeletal remains. This unique preservation of biomass is likely due to sequestration, & protection from degradation, for tens to hundreds of Ma by a rapid (days) microbial-induced carbonate deposition. A 380-Ma-old soft tissue crustacean inside a concretion was identified by the oldest recorded cholesterol; &, cholesterol, red blood cells, & collagen in a 183-Ma-old vertebra bone, encapsulated in a concretion, have provided an unprecedented insights into the Jurassic paleoenvironment, predatory lifestyle & diet of an ichthyosaur. Fossil concretions are a previously untapped biochemical record – providing many unique insights: *e.g.* diet; role of MMs in fossilisation; & the unique chemical pathways of natural products into biomarkers.

The rise of eukaryotes

SUSANNAH M. PORTER, UNIVERSITY OF CALIFORNIA AT SANTA BARBARA, USA

Eukaryotes include animals, plants, fungi, seaweeds, and a variety of organisms collectively referred to as protists. Though this last group is often dismissed as merely a collection of 'tiny animals and plants', protists exhibit a stunning diversity of forms, behaviors, and ecologies, and the tiny worlds they inhabit are just as fascinating as the better-studied ecosystems of their macroscopic relatives. Protists are also the ancestors of those macroscopic organisms: the early history of eukaryotes is a history of microbial life. Over the past 60 years, the details of that early history have been fleshed out, much of it through the efforts of Andy Knoll and his students, postdocs, and collaborators, with studies of Proterozoic body fossils and fossil hydrocarbon molecules, augmented by molecular clock analyses. A number of significant questions remain, however, including when and how the first complex eukaryotic cells evolved, which habitats these early protists occupied, and what drove their initial diversification. I will review this early fossil record and highlight two alternative models of early eukaryote evolution that fit the available data. In one model, complex eukaryotic cells evolved very early (ca. 2 billion years ago), but eukaryotes remained minor components of microbial ecosystems for hundreds of millions of years, restricted to patchy oxygen oases, and diversifying later in response to increasing oxygen and nutrient levels. In an alternative model, complex eukaryotic cells evolved over a prolonged (>1 billion year) interval, with early eukaryotes inhabiting anoxic habitats. In this view, eukaryotes flourished not long after the last common ancestor of modern eukaryotes had evolved, and perhaps shortly after they had adapted to oxygenated settings. I will also present evidence that the appearance of microscopic protistan predators may have played a role in the rise of eukaryotes at the end of the Proterozoic Era.

Exploring extant algae for signals of ancient atmospheres as influenced by life

ROSALIND E. M. RICKABY, UNIVERSITY OF OXFORD, UK

The history of life on Earth leaves an indelible footprint in the changing chemistry of Earth's surface. Evolving life repeatedly catalysed its own potential downfall via the unwitting release of new and initially toxic chemicals. Earth transformed from a suffocating oxygen-free planet to an aerobic world by the proliferation of the ancestors of cyanobacteria. These microscopic cells contaminated the ocean and atmosphere with the ultimate oxidant and poison to organisms at that time: oxygen. This oxygenation dramatically altered the trace element composition of the oceans, for example reducing the availability of iron, so integral for photosynthesis, but increasing e.g. the availability of Zn. In combination with additional energy, however, evolution has found solutions to manage and use that waste, and cope with restricted availability of key elements, creating new life chemistry, which then itself generates novel waste and so on: a cyclical driver for increasing complexity. Such a cycle of stress and invention, drives both adaptation and environmental selection of the fittest organisms, particularly amongst the photosynthetic phytoplankton that have experienced distinctive succession to the dominant species during different geological eras. Here, different lines of evidence will be drawn together from adaptive signals in genomes, physiology and biochemistry that there is a redox scale among different algal functional groups. This differential adaptation to oxygenation leaves imprints in the biochemistry of Rubisco, the enzyme that underpins all photosynthesis, and in the transporter and metalloproteome complement of adaptation to trace metal scarcity and availability. As a result of the feedback between environmental chemistry and life, deciphering the chemotypes of different forms of life can be used to reveal the geological history of changing atmosphere and ocean chemistry, as dictated by life itself.

The fossil record of early animals

SHUHAI XIAO, VIRGINIA TECH, BLACKSBURG, USA

Darwin was puzzled by the apparently abrupt appearance of animal fossils in the early Cambrian Period about 540–510 million years ago. Darwin argued that this abruptness may have been an artifact of massive preservation failure, which generates enormous paleontological gaps. The picture is also exacerbated by systematic extinction, which generates immense morphological gaps that can lead to what are often called major innovations because transitional forms have gone extinct. The paleontological gaps can be addressed by a thorough investigation of the Precambrian geological record, and numerous key discoveries have been made in recent decades through the study of exceptionally preserved macrofossils, microfossils, and molecular fossils of the Ediacaran Period (635–540 million years ago). To fill the morphological gaps, particularly the gaps between crown-group animals and their closest living sister-group, requires an understanding of where Ediacaran fossils sit in the family tree of animals. This is a challenging task because these fossils likely represent extinct stem-group lineages at various levels. As such, they are often not full-fledged animals because they may not have all features that collectively define modern or crown-group animals. They can also appear alien in one way or another, because they may evolve exotic features that are not present in modern animals. Consequently, they often do not fit the traditional search image that is anchored on crown-group animals. In this talk, I will illustrate these challenges using several key Ediacaran fossils as examples to highlight the progress paleontologists have made to fill Darwin's gaps.

PROGRAMME

Crafoord *Days* 2022

Overview programme Crafoord *Days* 2022

Monday 25 April | LUX, HELGONAVÄGEN 3, LUND — 09:30

THE CRAFOORD PRIZE LECTURE IN **MATHEMATICS**
Held by the Crafoord Laureate **Enrico Bombieri**.

THE CRAFOORD PRIZE LECTURE IN **ASTRONOMY**
Held by **Nicola Fox**, on behalf of the late Crafoord Laureate **Eugene N. Parker**.

THE CRAFOORD PRIZE LECTURE IN **POLYARTHRITIS**
Held by the Crafoord Laureate **Daniel L. Kastner**.

THE CRAFOORD PRIZE LECTURE IN **GEOSCIENCES**
Held by the Crafoord Laureate **Andrew H. Knoll**.

Registration at www.kva.se

Tuesday 26 April

09:35	CRAFOORD PRIZE SYMPOSIUM IN **MATHEMATICS** *Number Theory* Lectures by the Crafoord Laureate **Enrico Bombieri** and invited speakers.	THE FACULTY OF ENGINEERING, LTH, ANNEXET, MA5, SÖLVEGATAN 20, LUND
09:00	CRAFOORD PRIZE SYMPOSIUM IN **ASTRONOMY** *Solar wind and magnetic fields in space* Lectures by **Boon Chye Low**, on behalf of the late Crafoord Laureate **Eugene N. Parker** and invited speakers.	THE FACULTY OF ENGINEERING, LTH, ANNEXET, MA7, SÖLVEGATAN 20, LUND
09:00	CRAFOORD PRIZE SYMPOSIUM IN **POLYARTHRITIS** *Autoinflammatory diseases* Lectures by the Crafoord Laureate **Daniel L. Kastner** and invited speakers.	KULTUREN IN LUND, TEGNÉRSPLATSEN 6, LUND
09:30	CRAFOORD PRIZE SYMPOSIUM IN **GEOSCIENCES** *The evolution of life on Earth through deep time* Lectures by the Crafoord Laureate **Andrew H. Knoll** and invited speakers.	LUX, HELGONAVÄGEN 3, LUND

Wednesday 27 April | LUND UNIVERSITY ASSEMBLY HALL, UNIVERSITY MAIN BUILDING, PARADISGATAN 2, LUND — 16:15

THE CRAFOORD PRIZE AWARD CEREMONY
In the presence of **HRH Crown Princess Victoria**.

By invitation only.

Detailed programme

The Crafoord *Prize* Lectures in Mathematics, Astronomy, Polyarthritis and Geosciences

LUX,
HELGONAVÄGEN 3,
LUND

Monday 25 April

Seating is limited. For registration and further information visit:
www.kva.se/en/crafoordprizelectures2022

09:30	Presentation of the Crafoord *Prize*	Nils Dencker, Chair of the Crafoord Prize Committee in Mathematics
09:35	Introduction of the Crafoord Laureate in Mathematics 2020	Per Salberger, Member of the Royal Swedish Academy of Sciences
09:45	*The zeta function: a mystery 283 years old*	CRAFOORD LAUREATE Enrico Bombieri, School of Mathematics, Institute for Advanced Study, Princeton University, USA
10:20	Questions from the audience	CHAIR: Per Salberger, Member of the Royal Swedish Academy of Sciences
10:30	COFFEE BREAK	
10:50	Introduction of the Crafoord Laureate in Astronomy 2020	Dainis Dravins, Member of the Royal Swedish Academy of Sciences
11:00	*The Challenge of Exploring Our Sun: the 60-Year Odyssey to Parker Solar Probe*	Nicola Fox, Science Mission Directorate, NASA Headquarters, Washington, USA, on behalf of the late CRAFOORD LAUREATE Eugene N. Parker, University of Chicago, USA
11:35	Questions from the audience	CHAIR: Dainis Dravins, Member of the Royal Swedish Academy of Sciences
11:45	LUNCH	(Included for registered participants)
12:45	Introduction of the Crafoord Laureate in Polyarthritis 2021	Rikard Holmdahl, Member of the Crafoord Prize Committee in Polyarthritis
12:55	*Cutting the Gordian Knots of Inflammation with the Shears of Genomics*	CRAFOORD LAUREATE Daniel L. Kastner, National Human Genome Research Institute, Bethesda, USA
13:30	Questions from the audience	CHAIR: Rikard Holmdahl, Member of the Crafoord Prize Committee in Polyarthritis
13:40	COFFEE BREAK	
14:00	Introduction of the Crafoord Laureate in Geosciences 2022	Daniel Conley, Member of the Crafoord Prize Committee in Geosciences
14:10	*The Deep History of Life*	CRAFOORD LAUREATE Andrew H. Knoll, Harvard University, Cambridge, USA
14:45	Questions from the audience	CHAIR: Daniel Conley, Member of the Crafoord Prize Committee in Geosciences
14:55	End of the Crafoord *Prize* Lectures	

Detailed programme

THE CRAFOORD SYMPOSIUM IN GEOSCIENCES 2022

The evolution of life on Earth through deep time

LUX,
HELGONAVÄGEN 3,
LUND

Tuesday 26 April

Seating is limited. For registration and further information visit: www.kva.se/en/crafoordgeosciences2022

	MORNING SESSION	CHAIR: Barbara Wohlfarth, Chair of the Class of Geosciences, the Royal Swedish Academy of Sciences
09:30	Opening address	Hans Ellegren, Secretary General, the Royal Swedish Academy of Sciences
09:35	Presentation of the Crafoord Laureate	Martin Jakobsson, Chair of the Crafoord Prize Committee in Geosciences
09:45	*Phytoplankton in space and time*	CRAFOORD LAUREATE Andrew H. Knoll, Harvard University, Cambridge, USA
10:35	COFFEE BREAK	(Included for registered participants)
10:55	*Significance of microbes during mass extinction events and their role in exceptional fossil preservation*	Kliti Grice, Curtin University, Perth, Australia
11:35	*The rise of eukaryotes*	Susannah M. Porter, University of California at Santa Barbara, USA
12:15	LUNCH	(Included for registered participants)
	AFTERNOON SESSION	CHAIR: Vivi Vajda, Member of the Royal Swedish Academy of Sciences
13:15	*A case for an active eukaryotic marine biosphere during the Proterozoic Era: Fossils meet models*	Donald E. Canfield, University of Southern Denmark, Odense, Denmark
13:55	*Exploring extant algae for signals of ancient atmospheres as influenced by life*	Rosalind E. M. Rickaby, University of Oxford, UK
14:35	COFFEE BREAK	(Included for registered participants)
15:05	*The fossil record of early animals*	Shuhai Xiao, Virginia Tech, Blacksburg, USA
15:45	*Pumping and swimming through time*	Nicholas J. Butterfield, University of Cambridge, UK
16:25	Closing remarks	Stefan Bengtson, Member of the Royal Swedish Academy of Sciences
16.30	END OF SYMPOSIUM	

Anna-Greta and Holger Crafoord

HOLGER AND ANNA-GRETA CRAFOORD

Holger Crafoord (1908–1982) was prominent in Swedish industry and commerce. He began his career with AB Åkerlund & Rausing and devoted a larger part of his working life to this company. In 1964, Holger Crafoord founded Gambro AB in Lund, Sweden, where the technique of manufacturing the artificial kidney was developed. This remarkable dialyser soon became world famous. Since then, a series of medical instruments has been introduced on the world market by Gambro.

In 1980, Holger Crafoord founded the Crafoord Foundation, which annually contributes greatly to the Anna-Greta and Holger Crafoord Fund.

Holger Crafoord became an honorary doctor of economics in 1972 and in 1976 an honorary doctor of medicine at Lund Univeristy.

Anna-Greta Crafoord (1914–1994) took, as Holger Crafoord's wife, part in the development of Gambro AB. Through generous donations and a strong commitment in the society around her, she contributed to the scientific and cultural life. In 1986 she founded the Anna-Greta Crafoord foundation for rheumatological research and in 1987 Anna-Greta Crafoord became an honorary doctor of medicine at Lund Univeristy.

Over the years, the Crafoords have furthered both science and culture in many ways and it is noteworthy that research in the natural sciences has received an important measure of support from the Anna-Greta and Holger Crafoord Fund.

THE ROYAL SWEDISH ACADEMY OF SCIENCES was founded in 1739 and is an independent non-governmental organisation, whose overall objective is to promote the sciences and strengthen their influence in society. The Academy has a particular responsibility for natural science and mathematics, but its work strives to increase interaction between different disciplines. The activities of the Royal Swedish Academy of Sciences primarily focus on:

- being a voice of science in society and influencing research policy (policy for science)
- providing a scientific basis for public debate and decision-making (science for policy)
- recognizing outstanding contributions to research
- being a meeting place for science, within and across subject boundaries
- providing support for young researchers
- stimulating interest in mathematics and natural science in school
- disseminating knowledge to the public
- mediating international scientific contacts
- preserving scientific heritage

THE ACADEMY has around 460 Swedish and 175 foreign members who are active in classes, committees and working groups. They initiate enquiries, consultation documents, conferences and seminars. The Academy has General Meetings eight times a year. Open lectures are held in association with these (read more at www.kva.se/kalendarium). They can also be watched via www.kva.se/video.

THE ACADEMY´S institutes offer unique research environments in ecological economics, botany, the history of science and mathematics.

Every year, the Academy awards a number of prizes and rewards. The best known are the Nobel Prizes in Physics and Chemistry and the Sveriges Riksbank Prize in Economic Science in Memory of Alfred Nobel (the Prize in Economic Sciences). Other major prizes are the Crafoord Prize, Sjöberg Prize, Göran Gustafsson Prizes, Söderberg Prize and the Tobias Prize. The Göran Gustafsson Prizes are awarded to outstanding young researchers and are a combination of a personal prize and research funding. Since 2012, the Academy of Sciences has been one of the academies involved in implementing the Wallenberg Academy Fellows career programme, which provides long-term funding to the most promising young researchers. As well as a comprehensive range of scholarships, the Academy is also involved in appointments to research posts in a number of programmes funded by external foundations.

Through its working groups and committees, the Academy also works to promote sustainable, science-based societal development in the area of energy and the environment, among others. Issues relating to education and conditions for teachers are another major interest.
The Academy regularly organises lectures and workshops on various scientific topics for teachers and students. In the 1990s, the Academy and the Royal Swedish Academy of Engineering Sciences founded one of Sweden's biggest school development programmes, NTA – Naturvetenskap och teknik för alla (Science and Technology for all).

THE CRAFOORD PRIZE IS AWARDED IN PARTNERSHIP BETWEEN THE ROYAL SWEDISH ACADEMY OF SCIENCES AND THE CRAFOORD FOUNDATION IN LUND. THE ACADEMY IS RESPONSIBLE FOR SELECTING THE CRAFOORD LAUREATES.

WWW.CRAFOORDPRIZE.SE

KUNGL. VETENSKAPS-AKADEMIEN

THE ROYAL SWEDISH ACADEMY OF SCIENCES

BOX 50005, SE-104 05 STOCKHOLM, SWEDEN

TEL: +46 8 673 95 00 | KVA@KVA.SE | WWW.KVA.SE