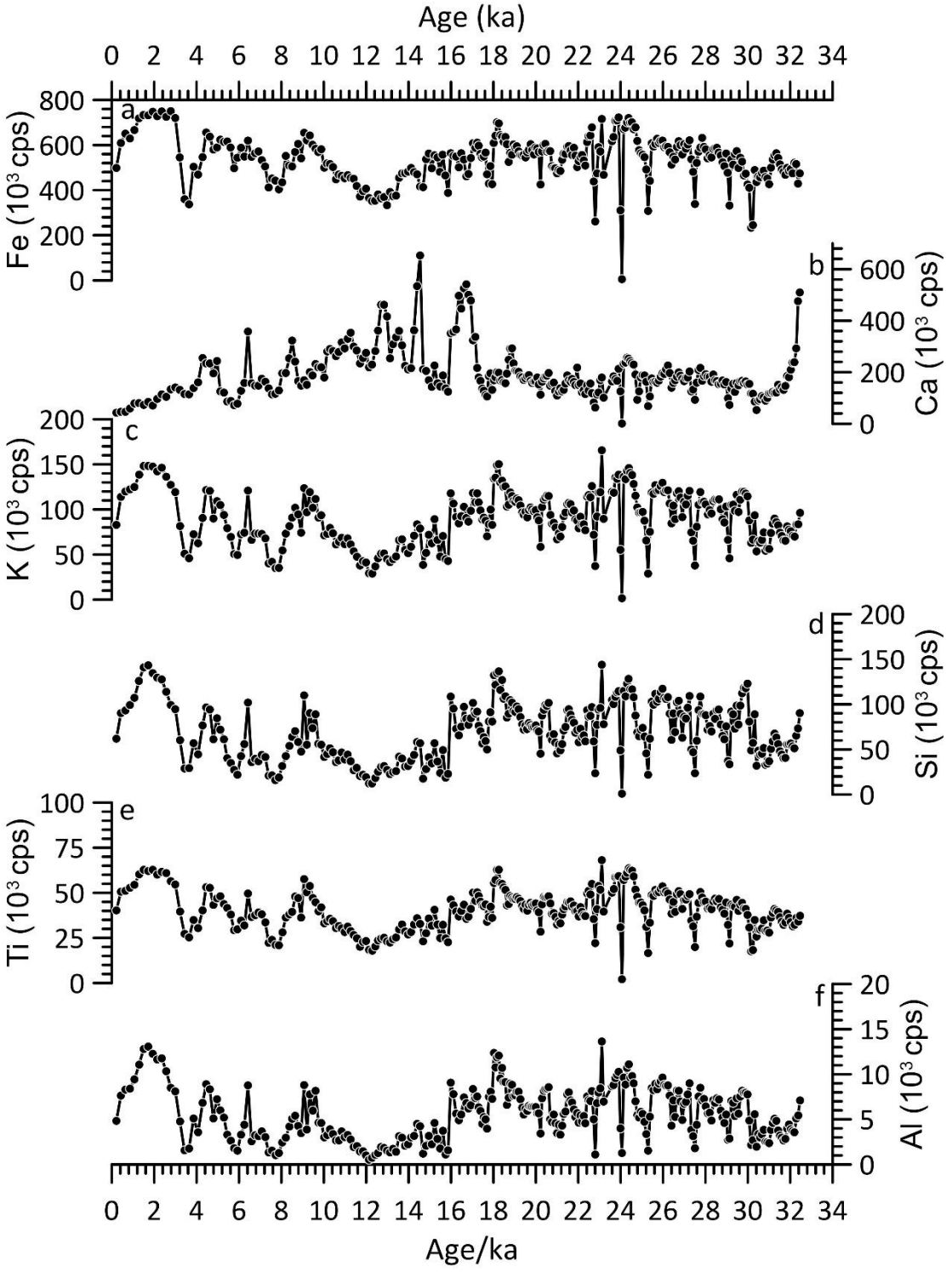

Figure S1. The relative contents of six elements in the core SCS GC-1.

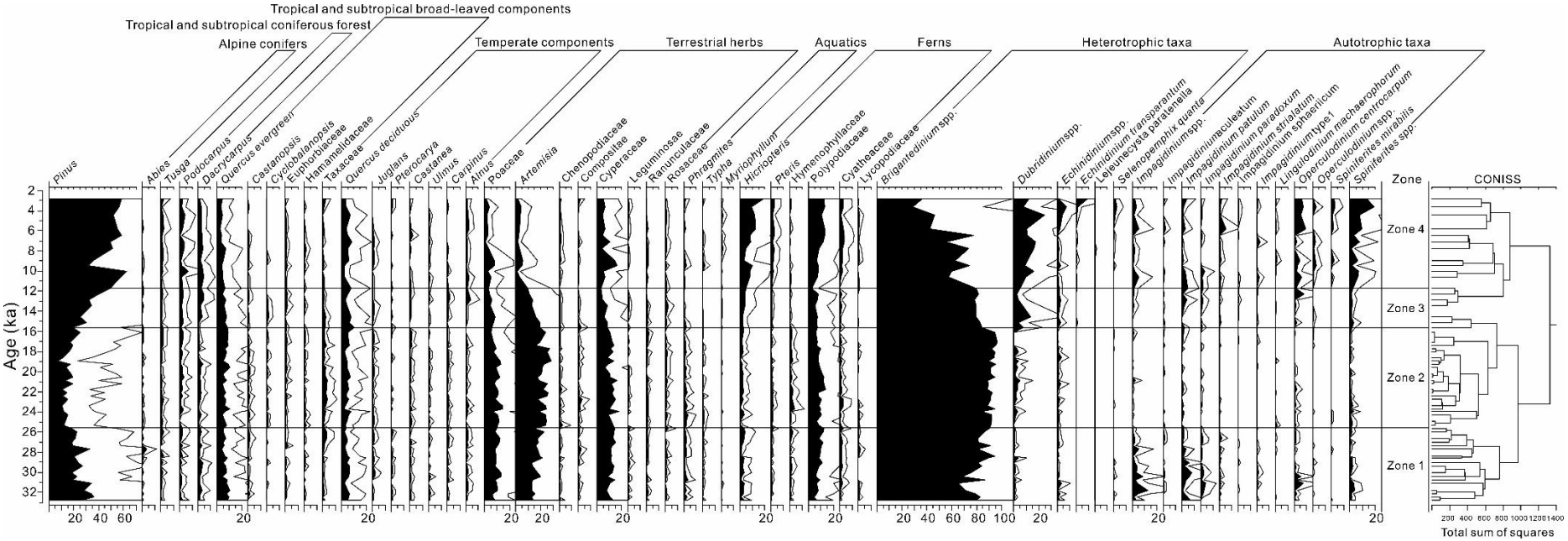

Figure S2. Percentages of pollen and dinocyst taxa in the core SCS GC-1.

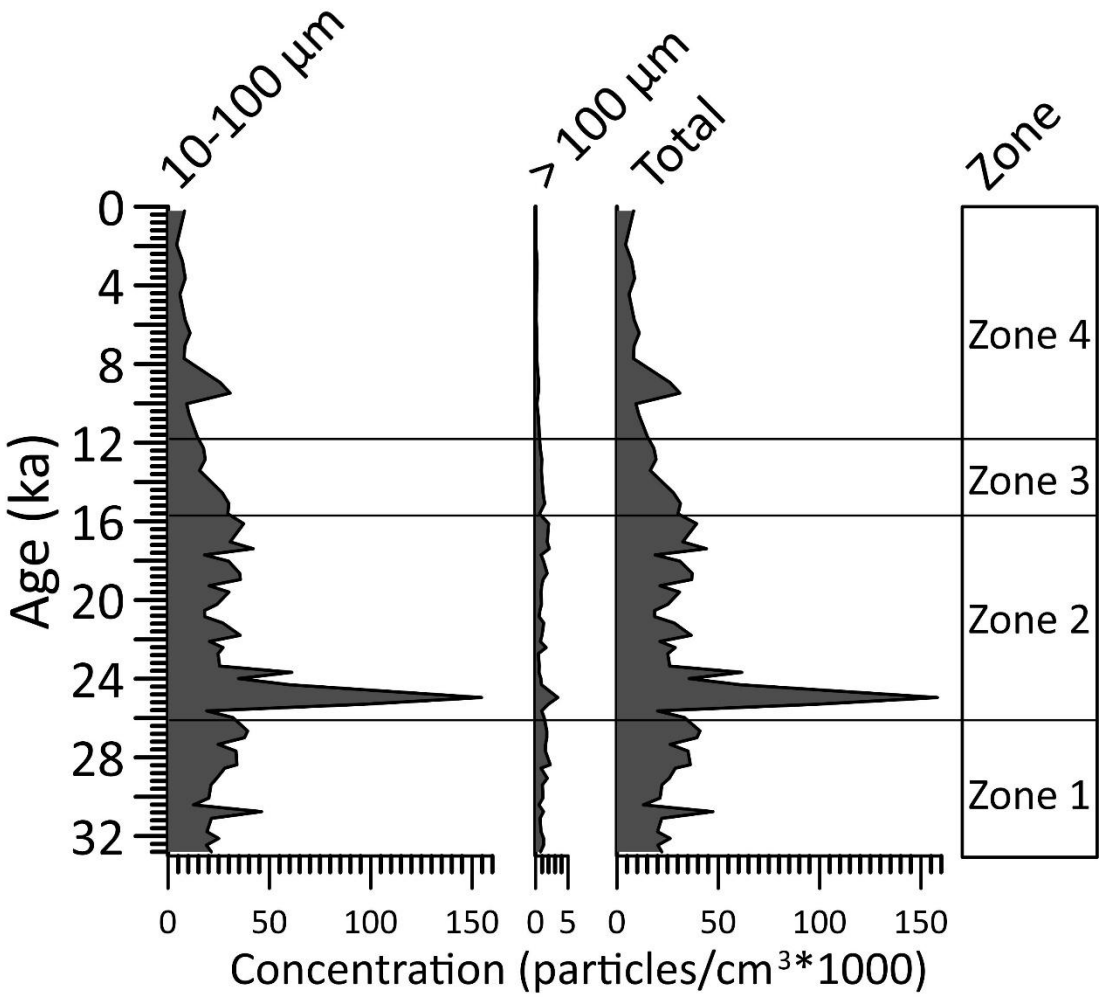

Figure S3. Microcharcoal concentrations with two size classes (10-100 µm and >100 µm) in the core SCS GC-1.

Table S1. List of organic-walled dinoflagellate cyst taxa identified in the core SCS GC-1.

Cyst name	Motile affinity	Palaeoecological interpretation	References
Protoperidiniaceae			
Brigantedinium spp.	Protoperidinium spp.	Related to upwelling or nutrient	Zonneveld and Pospelova, 2015; Marret and Zonneveld, 2003
Dubridinium spp.		Related to upwelling or nutrient	Zonneveld and Pospelova, 2015; Bouimetarhan et al. 2009
Echinidinium aculeatum	*Protoperidiniaceae*	Coastal areas with active upwelling; areas of increased nutrient and low salinity	Zonneveld and Pospelova, 2015; Pospelova and Kim, 2010
Echinidinium spp.	*Protoperidiniaceae*	Mesotrophic/eutrophic waters; upwelling	Zonneveld and Pospelova, 2015; Marret and Zonneveld, 2003
Echinidinium delicatum	*Protoperidiniaceae*	highest occurrence in the subtropics and tropics; coastal upwelling	Zonneveld and Pospelova, 2015; Verleye and Louwye, 2010
Echinidinium transparantum	*Protoperidiniaceae*	subtropical-tropical; relatively low SST and high SSS; upwelling; high productivity	Zonneveld and Pospelova, 2015; Kholeif, 2010; Bouimetarhan et al., 2009
Echinidinium zonneveldii	*Protoperidiniaceae*	Relatively low SST and high SSS; upwelling; high productivity	Zonneveld and Pospelova, 2015; Bouimetarhan et al., 2009
Lejeunecysta spp.		Shallow waters with high levels of productivity and nutrient content; freshwater inflows in estuarine environments	Zonneveld and Pospelova, 2015; Sluijs et al., 2005
Lejeunecysta oliva	*Protoperidinium sp.*	River outflow; warm, nutrient-rich, low-salinity waters	Zonneveld and Pospelova, 2015; Vink et al., 2000
Lejeunecysta sabrina	*? Protoperidinium leonis*	Temperate to tropical coastal areas	Zonneveld et al., 2013; Nieuwenhove et al., 2020
Lejeunecysta paratenella	*? Protoperidinium sp.*	Cool, nutrient-rich waters; likely related to upwelling	Zonneveld and Pospelova, 2015; Zhao et al., 2017
Quinquecuspis concreta	*? Protoperidinium leonis*	Inner-outer shallow sea, cold temperate to tropical zone; full of nutrition; river impact	Zonneveld and Pospelova, 2015; Nieuwenhove et al., 2020
Selenopemphix quanta	*Protoperidinium conicum*	Highest abundances in subtropical and tropical; nutrient-rich waters	Zonneveld and Pospelova, 2015; Zonneveld et al., 2013
Selenopemphix nephroides	*Protoperidinium subinerme*	Warm and productive shallow waters; upwelling	Zonneveld and Pospelova, 2015; Ramírez-Valencia et al., 2021
Selenopemphix stellatum		Adapted to variable salinity, meso-eutrophic, and oxygenated waters	Zonneveld and Pospelova, 2015
Stelladinium robustum	*Protoperidinium sp.*	Tropical to equatorial, mesotrophic to eutrophic environments; Increased mixing and cooling of the upper water column	Zonneveld and Pospelova, 2015; Zonneveld et al., 2013
Trinovantedinium applanatum	*Protoperidinium pentagonum*	River outflow; warm, nutrient-rich, low-salinity waters	Zonneveld and Pospelova, 2015; Vink et al., 2000
Votadinium calvum	*Protoperidinium oblongum*	Subpolar/temperate-equator; inner shallow sea/nearshore estuarine environment	Zonneveld and Pospelova, 2015; Marret and Zonneveld, 2003
Protoperidinium americanum	*Protoperidinium americanum*	High productivity and nutritional levels; coastal upwelling	Zonneveld and Pospelova, 2015; Pospelova et al., 2008
Protoperidinium monospinum	*Protoperidinium monospinum*	High nutrient in tropical-equatorial river outflow and upwelling areas	Zonneveld and Pospelova, 2015; Zonneveld et al., 2013
Pyxidinopsis reticulata		Eurythermal; High-salinity tolerant	Zonneveld et al., 2013
Polykrikaceae			
Polykrikos kofoidii	*Polykrikos kofoidii*	Nutrient-rich upwelling conditions in temperate to subtropical regions; inner shallow sea	Zonneveld and Pospelova, 2015; Marret and Zonneveld, 2003

Polykrikos schwartzii	*Polykrikos schwartzii*	Nutrient-rich upwelling conditions in temperate to subtropical regions	Zonneveld and Pospelova, 2015; Marret and Zonneveld, 2003
Gymnodiniaceae			
Gymnodinium microreticulatum	*Gymnodinium microreticulatum*	Coastal areas in temperate to subtropical, oligotrophic to mesotrophic regions	Zonneveld and Pospelova, 2015; Zonneveld et al., 2013
Gymnodinium catenatum	*Gymnodinium catenatum*	It inhabits tropical/subtropical high-productivity marine areas, has a low tolerance for temperature/salinity fluctuations, and its survival strictly depends on nutrient-rich waters brought by upwelling or vertical mixing.	Zonneveld et al., 2013
Gonyaulacaceae			
Bitectatodinium spongium		Prefers warm and saline environments; fully marine environments	Zonneveld et al., 2013
Impagidinium spp.	*Gonyaulax sp.*	Oligotrophic marine; sea level rise	Zonneveld and Pospelova, 2015; Powell et al., 1996
Impagidinium aculeatum	*Gonyaulax sp.*	Relatively warm, high-salinity, oligotrophic open-ocean environments	Zonneveld et al., 2013
Impagidinium paradoxum	*Gonyaulax sp.*	A species with broad temperature tolerance, high-salinity marine habitat preference, and optimal growth in oligotrophic waters	Zonneveld et al., 2013
Impagidinium patulum	*Gonyaulax sp.*	Warm, high-salinity, oligotrophic open-ocean preference	Zonneveld et al., 2013
Impagidinium plicatum	*Gonyaulax sp.*	There existed warm, normal-salinity, nutrient-depleted oligotrophic sea areas	Zonneveld et al., 2013
Impagidinium sphaericum	*Gonyaulax sp.*	A species widely distributed in the open ocean, characterized as eurythermal and eurytrophic, with a preference for eutrophic marine environments	Zonneveld et al., 2013
Impagidinium strialatum	*Gonyaulax sp.*	An oligotrophic species distributed in the low- to mid-latitude open ocean, adapted to temperate and tropical climates	Zonneveld et al., 2013
Lingulodinium machaerophorum	*Lingulodinium polyedrum*	Inner shallow sea; tropical-subtropical; high productivity	Zonneveld and Pospelova, 2015; Marret and Zonneveld, 2003
Nematosphaeropsis labyrinthus	*Gonyaulax spinifera*	Tropical and subtropical; oligotrophic marine; sea level rise	Zonneveld and Pospelova, 2015; Wall et al., 1977
Operculodinium spp.		Open ocean; cosmopolitan species	Zonneveld and Pospelova, 2015; Wall et al., 1977
Operculodinium centrocarpum	*Protoceratium reticulatum*	Cosmopolitan species; intersection of oceanic and shallow water masses, cold/temperate zones, higher nutrients	Zonneveld and Pospelova, 2015; Zonneveld et al., 2013
Operculodinium janduchenei		Temperate-equatorial; oligotrophic to eutrophic environment	Zonneveld and Pospelova, 2015; Zonneveld et al., 2013
Operculodinium israelianum	*?Protoceratium sp.*		Zonneveld et al., 2013
Polysphaeridium zoharyi	*Pyrodinium bahamense*	Subtropical inner shallow sea; declined abundance with rising sea levels; typical lagoon and shallow water species	Zonneveld and Pospelova, 2015; Wall et al., 1977
Spiniferites bentori	*Gonyaulax sp.*	Warm conditions	Zonneveld and Pospelova, 2015
Spiniferites mirabilis	*Gonyaulax spinifera complex*	Warm conditions; shallow to ocean area	Zonneveld and Pospelova, 2015; Marret and Zonneveld, 2003
Spiniferites spp.	*Gonyaulax spp.*	Outer shallow sea; high SST, weak upwelling and fully oceanic conditions	Zonneveld and Pospelova, 2015; Zonneveld et al., 2013
Tuberculodinium vancampoae	*Pyrophacus steinii*	Tropical to subtropical; inner shallow seas and lagoons	Zonneveld and Pospelova, 2015; Versteegh and Zonneveld, 1994

SST: sea surface temperature; SSS: sea surface salinity.