DESCRIPTIONS OF OVERLAP ASSEMBLAGES AND TECTONOSTRATIGRAPHIC TERRANES, DEFINITIONS, AND METHODS FOR COMPILATION FOR NORTHEAST ASIA GEODYNAMICS MAP

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Introduction and Companion Studies

This text provides an introduction for the Northeast Asia geodynamics map, and for the companion descriptions of tectonostratigraphic terranes, overlap assemblage, and cited references. The geodynamics map is synthesized, compiled, described, and interpreted with the use of modern concepts of plate tectonics, and analysis of terranes and overlap assemblages. The map is the result of a detailed compilation and synthesis at a scale of 1:5,000,000.

This text and companion materials are part of a major international collaborative study of the *Mineral Resources, Metallogenesis, and Tectonics of Northeast Asia* that was conducted from 1997 through 2002 by geologists from earth science agencies and universities in Russia, Mongolia, northern China, South Korea, Japan, and the USA. The goals and major and minor publications for this project are described in a pamphlet entitled NE_Asia_Project_Pamphlet in the directory entitled PROJMAT.

This report is one of a series of reports on the mineral resources, metallogenesis, geodynamics, and metallogenesis of Northeast Asia. Companion studies are other articles and maps on this CD-ROM, and various detailed reports in preparation: (1) a detailed geodynamics map of Northeast Asia (Parfenov and 2003); (2) a compilation of major mineral deposit models (Rodionov and Nokleberg, 2000; Obolenskiy and others, 2003a); (3) a series of metallogenic belt maps (Obolenskiy and others, 2001; 2003b); (4) a lode mineral deposits and placer districts location map for Northeast Asia (Obolenskiy and others, 2003b); (5) descriptions of metallogenic belts (Rodionov and others, 2000; this report; and (6) a database on significant metalliferous and selected nonmetalliferous lode deposits, and selected placer districts (Ariunbileg and others, 2003).

Key Concepts for Compilation of Map

The companion Northeast Asia Geodynamics Map presents a modern description of the major geologic and tectonic units of the region. The map illustrates both the onshore terranes and overlap volcanic assemblages of the region, and the major offshore geologic features. The map is the first collaborative compilation of the geology of the region at a scale of 1:5,000,000 by geologists from Russia, Mongolia, China, South Korea, Japan, and the USA. The map is designed to be a source of geologic information for all scientists interested in the region, and is designed to be used for several purposes, including regional tectonic analyses, mineral resource and metallogenic analyses, petroleum analyses, neotectonic analyses, and analyses of seismic hazards and volcanic hazards.

This map is the result of extensive geologic mapping and associated tectonic studies in Northeast Asia in the last few decades. Geologic mapping suggests that most of this region can be interpreted as a collage of fault-bounded tectonostratigraphic terranes that were accreted onto cratons and continental margins during the Paleozoic, Mesozoic, and Cenozoic.

A key definition for the map is *tectonostratigraphic terrane* which is defined below, along with other key terms, as a fault-bounded geologic entity or fragment that is characterized by a distinctive geologic history that differs markedly from that of adjacent terranes (Jones and others, 1983; Howell and others, 1985). A tectonostratigraphic terrane (hereafter referred to as *terrane*) is a fault-bounded, stratigraphically coherent assemblage that formed before accretion, i.e. tectonic juxtaposition, to adjacent units. A few terranes are fault-bounded structural complexes, mainly subduction zone or accretionary-wedge complexes. The terranes are bounded by various types of major faults or fault zones, termed sutures. Paleontologic, stratigraphic, and paleomagnetic evidence suggests that some terranes were originally widely separated from one another, or from the North Asia or Sino-Korean (South China or Yangzi) Cratons. But other terranes are interpreted to be displaced from one another or from a another loci on the same continent by distances of less than hundreds of kilometers.

On the companion map, terranes are interpreted and colored according to inferred tectonic environments. These environments are: (1) cratonal; (2) passive continental margin; (3) metamorphosed continental margin; (4) continental-margin arc; (5) island arc; (6) oceanic crust, seamount, and ophiolite; (7) accretionary wedge and subduction zone; (8) turbidite basin; (9) transform continental-margin arc, and (10) metamorphic for terranes that are too highly-deformed and metamorphosed to determine the original tectonic environment. For terranes with complex geologic histories, the chosen color indicates the tectonic environment most prevalent during this history of the terrane. Terranes in early Precambrian crystalline basement of cratons are also delineated and are colored according to major lithologies.

In addition to terranes, the map also depicts postaccretion units that include: (1) Paleozoic, Mesozoic, and Cenozoic and overlap assemblages of sedimentary and volcanic rocks that are deposited across two or more terranes that formed generally after accretion of most terranes in the region; (2) Paleozoic, Mesozoic, and Cenozoic basinal deposits that occur within a terrane or on cratons; and (3) plutonic rocks. The postaccretion igneous units are identified by age-lithologic abbreviations and by name. These overlap assemblages and basinal deposits formed mainly during sedimentation and magmatism that occurred after accretion of terranes to each other or to a continental margin. Overlap assemblages provide minimum ages on the timing of accretion of terranes. Some overlap assemblages and basinal deposits, as well as fragments of terranes, are extensively offset by movement along postaccretion faults. In offshore areas, the map depicts major oceanic plates, ocean floor magnetic lineations, oceanic spreading ridges, and seamounts. For onshore units, the map also depicts active continental margin and island arc-related assemblages, orogenic belt assemblages, magmatic formations, and transform-plate-boundary-related assemblages. In addition, the map depicts younger neotectonic features, including active faults, active volcanoes, astroblemes, aulacogen, and rifts.

The map consists of two sheets. Sheet 1 is the map at a scale of 1:5,000,000. Sheet 2 is the explanation and list of map units. The map was mainly compiled from sources listed in the section on source references.

Key Tectonic Definitions

For the compilation, synthesis, description, and interpretation of metallogenic belts, the following and mineral deposit, metallogenic, and tectonic definitions are employed. The definitions are adapted from Coney and others (1980), Jones and others (1983), Howell and others (1985), Monger and Berg (1987), Nokleberg and others (1994a, b, 1998; 2001), Wheeler and others (1988), and Scotese and others (2001).

Accretion. Tectonic juxtaposition of two or more terranes, or tectonic juxtaposition of terranes to a craton margin. Accretion of terranes to one another or to a craton margin also defines a major change in the tectonic evolution of terranes and craton margins.

Accretionary wedge and subduction-zone terrane. Fragment of a mildly to intensely deformed complex consisting of varying amounts of turbidite deposits, continental-margin rocks, oceanic crust and overlying units, and oceanic mantle. Divided into units composed predominantly of turbidite deposits or predominantly of oceanic rocks. Units are interpreted to have formed during tectonic juxtaposition in a zone of major thrusting of one lithosphere plate beneath another, generally in zones of thrusting along the margin of a continent or an island arc. May include large fault-bounded units with a coherent stratigraphy. Many subduction-zone terranes contain fragments of oceanic crust and associated rocks that exhibit a complex structural history, occur in a major thrust zone, and possess blueschist-facies metamorphism.

Collage of terranes. Groups of tectonostratigraphic terranes, generally in oceanic areas, for which insufficient data exist to separate units.

Craton. Chiefly regionally metamorphosed and deformed shield assemblages of Archean and Early Proterozoic sedimentary, volcanic, and plutonic rocks, and overlying platform successions of Late Proterozoic, Paleozoic, and local Mesozoic and Cenozoic sedimentary and lesser volcanic rocks.

Craton margin. Chiefly Late Proterozoic through Jurassic sedimentary rocks deposited on a continental shelf or slope. Consists mainly of platform successions. Locally has, or may have had an Archean and Early Proterozoic cratonal basement.

Cratonal terrane. Fragment of a craton.

Continental-margin arc terrane. Fragment of an igneous belt of coeval plutonic and volcanic rocks, and associated sedimentary rocks that formed above a subduction zone dipping beneath a continent. Inferred to possess a sialic basement.

Deposit. A general term for any lode or placer mineral occurrence, mineral deposit, prospect, and (or) mine.

Island-arc terrane. Fragment of an igneous belt of plutonic rocks, coeval volcanic rocks, and associated sedimentary rocks that formed above an oceanic subduction zone. Inferred to possess a simatic basement.

Metamorphic terrane. Fragment of a highly metamorphosed or deformed assemblage of sedimentary, volcanic, or plutonic rocks that cannot be assigned to a single tectonic environment because the original stratigraphy and structure are obscured. Includes intensely-deformed structural melanges that contain intensely-deformed fragments of two or more terranes.

Metamorphosed continental margin terrane. Fragment of a passive continental margin, in places moderately to highly metamorphosed and deformed, that cannot be linked with certainty to the nearby craton margin. May be derived either from a nearby craton margin or from a distant site.

Oceanic crust, seamount, and ophiolite terrane. Fragment of part or all of a suite of *eugeoclinal* deep-marine sedimentary rocks, pillow basalt, gabbro, and ultramafic rocks that are interpreted as oceanic sedimentary and volcanic rocks and the upper mantle. Includes both inferred offshore oceanic and marginal ocean basin rocks, minor volcaniclastic rocks of magmatic arc derivation, and major marine volcanic accumulations formed at a hotspot, fracture zone, or spreading axis.

Overlap assemblage. A postaccretion unit of sedimentary or igneous rocks deposited on, or intruded into, two or more adjacent terranes. The sedimentary and volcanic parts either depositionally overlie, or are interpreted to have originally depositionally overlain, two or more adjacent terranes, or terranes and the craton margin. Overlapping plutonic rocks, which may be coeval and genetically related to overlap volcanic rocks, link or stitch together adjacent terranes, or a terrane and a craton margin.

Passive continental margin terrane. Fragment of a craton margin.

Post-accretion rock unit. Suite of sedimentary, volcanic, or plutonic rocks that formed in the late history of a terrane, after accretion. May occur also on adjacent terranes or on the craton margin either as an overlap assemblage or as a basinal deposit. A relative-time term denoting rocks formed after tectonic juxtaposition of one terrane to an adjacent terrane.

Pre-accretion rock unit. Suite of sedimentary, volcanic, or plutonic rocks that formed in the early history of a terrane, before accretion. Constitutes the stratigraphy and igneous geology inherent to a terrane. A relative-time term denoting rocks formed before tectonic juxtaposition of one terrane to an adjacent terrane.

Subterrane. A fault-bounded unit within a terrane that exhibit similar, but not identical geologic history relative to another fault bounded unit in the same terrane.

Superterrane. An aggregate of terranes that is interpreted to share either a similar stratigraphic kindred or affinity, or a common geologic history after accretion (Moore, 1992). An approximate synonym is *composite terrane*.

Tectonic linkage. The interpreted association of a suite of coeval tectonic units that formed in the same region and as the result of the same tectonic processes. An example is the linking of a coeval continental-margin arc, forearc deposits, a back-arc rift assemblage, and a subduction-zone complex, all related to the underthrusting of a continental margin by oceanic crust.

Tectonostratigraphic terrane. A fault-bounded geologic entity or fragment that is characterized by a distinctive geologic history that differs markedly from that of adjacent terranes (Jones and others, 1983; Howell and others, 1985).

Transform continental-margin arc. An igneous belt of coeval plutonic and volcanic rocks, and associated sedimentary rocks that formed along a transform fault that occurs along the margin of a craton, passive continental margin, and (or) collage of terranes accreted to a continental margin.

Turbidite basin terrane. Fragment of a basin filled with deep-marine clastic deposits in either an orogenic forearc or backarc setting. May include continental-slope and continental-rise turbidite deposits, and submarine-fan turbidite deposits deposited on oceanic crust. May include minor epiclastic and volcaniclastic deposits.

Geologic Time Scale

Geologic time scale units are according to the IUGS Global Stratigraphic Chart (Remane, 1998). For this study, for some descriptions of geologic units, the term *Riphean* is used for the Mesoproterozoic through Middle Neoproterozoic (1600 to 650 Ma), and the term *Vendian* is used for Neoproterozoic III (650 to 540 Ma).

Descriptions of Terranes and Overlap Assemblages

This publication also includes descriptions of tectonostratigraphic terranes and overlap assemblages of Northeast Asia. The descriptions of terranes and overlap assemblages are provided in the directory /descriptions/ along with complete references. The descriptions of terranes and overlap assemblages are illustrated in stratigraphic columns, described below.

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