Timing of continental building in the Sveconorwegian orogen, SW Scandinavia

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The timing of continental building in the Sveconorwegian orogen of SW Scandinavia is evaluated with zircon U-Pb geochronology. ID-TIMS, LA-ICPMS and SIMS data are reported for 21 samples of orthogneiss, metarhyolite and metasandstone in S Norway, with emphasis on the Suldal area. The Sveconorwegian orogen is divided into a reworked Fennoscandian 1.80-1.64 Ga parautochthonous segment, the Eastern Segment, and two allochthonous terranes. The Idefjorden terrane is interpreted as a composite 1.66-1.52 Ga arc formed at the margin or near the margin of Fennoscandia. The western terrane, including the Telemark, Hardangervidda, Suldal and Rogaland-Vest Agder sectors, is named Telemarkia. U-Pb zircon data indicate that Telemarkia was built during a short magmatic event between 1.52 and 1.48 Ga, and was located at the margin of a Palaeoproterozoic craton, possibly Fennoscandia. No basement older than 1.5 Ga can be positively identified. In the early stage of the Sveconorwegian orogeny, Telemarkia collided with the Idefjorden terrane. The Bamble-Kongsberg sector, characterized by a mixed lithology and 1.13-1.10 Ga early-Sveconorwegian high-grade metamorphism, is interpreted as the original collision zone between these terranes.

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Introduction

The Sveconorwegian orogen of SW Scandinavia represents a truncated and comparatively small segment of the global Grenvillian belt. The Sveconorwegian orogen results from a collision between Fennoscandia and an unknown craton at the end of the Mesoproterozoic (1.1-1.0 Ga). It consists of late-Palaeoproterozoic to Mesoproterozoic continental domains reworked during the Sveconorwegian orogeny and displaced along lithospheric-scale Sveconorwegian shear zones (Figs. 1, 2; Berthelsen 1980; Park et al. 1991; Gorbatschev & Bogdanova 1993; Romer 1996; Bingen et al. 2001a; Andersen et al. 2002b). Progress in the understanding of the Sveconorwegian orogeny, and more globally of the Grenvillian orogeny, requires large-scale evaluation of continental building in the different domains exposed in the orogen. In this paper, zircon U-Pb geochronological data are reported for 21 samples of magmatic and metasedimentary rocks in the previously poorly investigated western part of the Sveconorwegian orogen. These data are combined with published data (e.g. Åhäll et al. 2000; Söderlund et al. 2002; Andersen et al. 2004), to provide an overview of the main magmatic events embodied in the Sveconorwegian orogen. Available data lead to an improved geometric model for assembly of the Sveconorwegian orogen.

Sampling and analytical methods

Samples were collected along a broad E-W transect across the western part of the Sveconorwegian orogen in S Norway. These include metavolcanic, metaigneous and metasedimentary rocks from pre-Sveconorwegian supracrustal complexes and their possible basement (Figs. 3, 4, 5; Table 1). Publised maps of the sampled area are those of Sigmond (1975, 1998), Ragnhildstveit et al. (1998) and Nordgulen (1999). For one of the sampling sites, namely Skånevik, an improved local geological map is presented (See Fig. 5).

Zircon was separated for U-Pb geochronology using a water table, heavy liquids and a magnetic separator. Zircon from seven samples was analysed by isotope dilution - thermal ionisation mass spectrometry (ID-TIMS) in the laboratories of Washington University, St. Louis, following a method outlined by Tucker et al. (1999). The analyses were done on non-magnetic, clear, crystals, abraded before dissolution (Table 2). Zircon from four samples was analysed by secondary ion mass spectrometry (SIMS) using the CAMECA IMS 1270 instrument at the NORDSIM laboratory, Swedish Museum of Natural History, Stockholm (Tables 3, 4). Zircon from the ten remaining samples was analysed by laser ablation - inductively coupled plasma mass

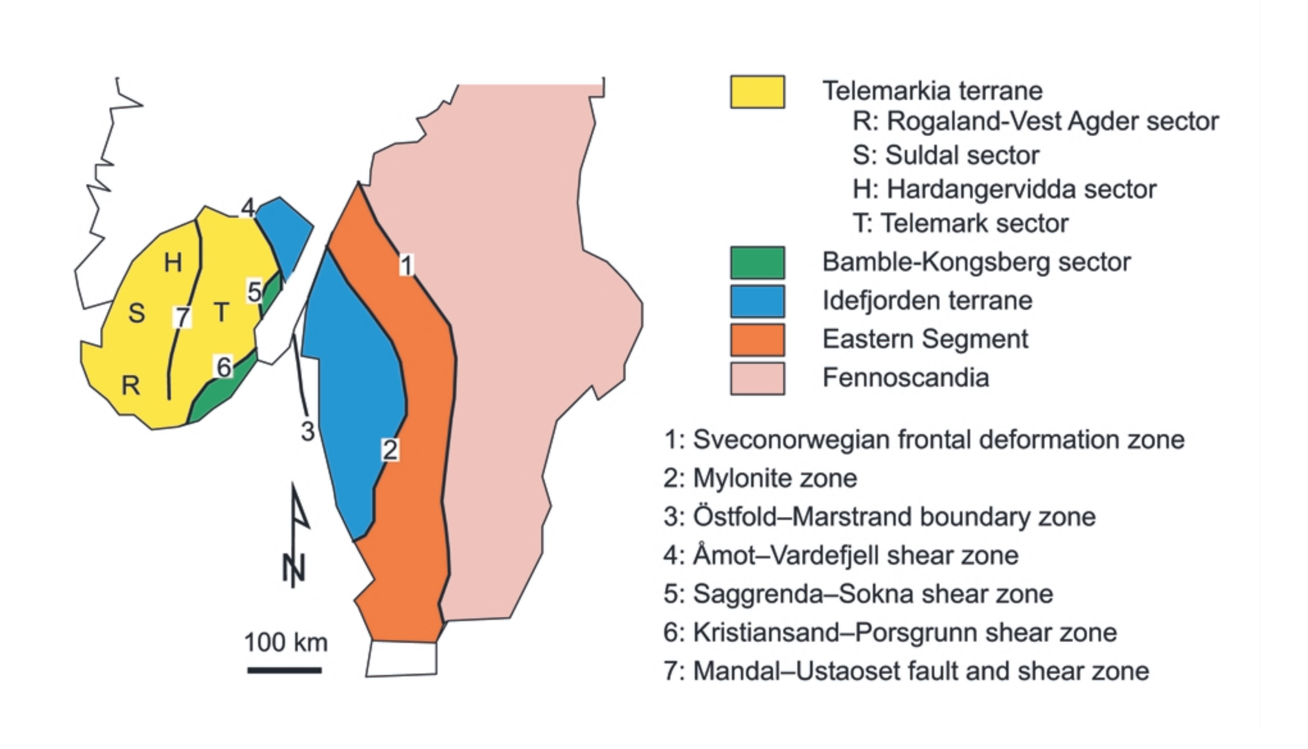

Fig. 1. Situation map of SW Scandinavia with lithotectonic domains and shear zones used in this work.

spectrometry (LA-ICPMS) at the Geological Survey of Norway, Trondheim (Table 5). For the SIMS and LA-ICPMS analyses, 20 to 60 zircon crystals were mounted in epoxy and polished to approximately half thickness. Cathodoluminescence (CL) images were obtained with a scanning electron microscope of all crystals before U-Pb analysis (Fig. 6).

The SIMS analytical method, data reduction, error propagation and assessment of the results are outlined in Whitehouse et al. (1997, 1999). The analyses were conducted with a spot size of ca. 30 µm, and calibrated to the Geostandard 91500 reference zircon with an age of 1065 Ma (Wiedenbeck et al. 1995). The error on the U/Pb ratio includes propagation of the error on the day-to-day calibration curve obtained by regular analysis of the reference zircon. A common Pb correction is applied using the ^{204}Pb analysis.

The LA-ICPMS data were collected on a Finnigan ELEMENT1 single collector high-resolution sector ICPMS, alimented by a Finnigan 266 nm laser microsampler. The analytical method is summarized hereafter. After a pre-analysis cleaning ablation, one or two analyses are performed with a ca. 10-15 µm laser beam rastered over an area of ca. 60 x 80 µm over the crystal section (Fig. 6). The beam frequency is 10 Hz. The beam energy ranges from 0.1 to 1.0 mJ and is adjusted for every sample or standard to obtain a ^{238}U signal around 2x10^{6} counts/sec. The aerosol is transported from the sample chamber in He gas, and introduced in the plasma in a mixture of He and Ar gas. The data are acquired in a time-resolved counting scanning mode for 60 sec. Masses ^{202}Hg, ^{204}(Hg + Pb), ^{206}Pb, ^{207}Pb, ^{208}Pb, ^{232}Th and ^{238}U are measured. The interference between ^{204}Pb and ^{204}Hg contained in the Ar gas is corrected by monitoring ^{202}Hg and assuming a ^{204}Hg/^{202}Hg ratio of 0.2293. A 60 sec gas blank analysis is performed between each zircon analysis. The measured isotope ratios are corrected for element- and mass-bias effects using the Geostandard 91500 reference zircon. One analysis of the standard is run after every five analyses of the unknown. The analytical setting provides an intensity for the ^{207}Pb signal higher than 1.5x10^{4} counts/sec. Analyses during which the zircon crystal brake are discarded. A common Pb correction is applied using the ^{204}Pb analysis. The data reduction is performed with help of an in-house developed program (Microsoft Excel spreadsheets and Visual Basic macros). Concentrations of U, Pb and Th are not derived from the data. Only element and isotope ratios are manipulated (Table 5). Concordia diagrams and age calculations are generated with the ISOPLOT program (Ludwig 2001). For the ten samples analysed in this study, upper intercept ages and weighted mean ^{207}Pb/^{206}Pb ages are statistically equivalent. We choose to quote the weighted mean ^{207}Pb/^{206}Pb ages in Table 1 and relevant figures. To monitor the accuracy of the LA-ICPMS method, zircon crystals from reference samples with compositions measured by ID-TIMS and ages ranging from Permian to Archaean are analysed together with the unknown samples. A summary of

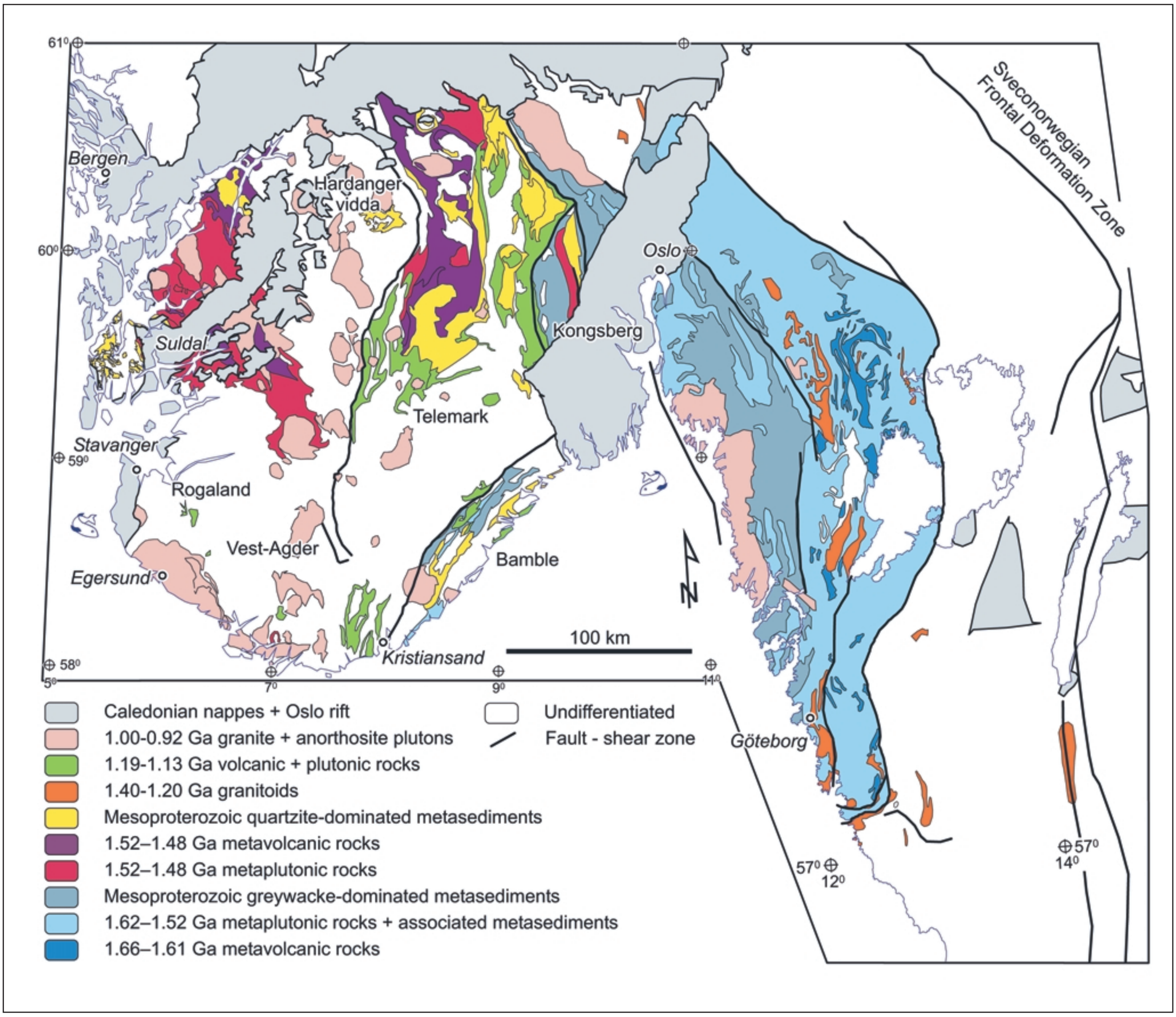

Fig. 2. Geological sketchmap of SW Scandinavia showing the distribution of important Mesoproterozoic lithological units and late-Sveconorwegian plutonism, modified after Koistinen et al (2001).

intercept ages obtained during a period overlapping with data collection for this study (Table 6) indicates that the deviation between LA-ICPMS and ID-TIMS ages is around 0.5 %.

Geochronology of the Sveconorwegian orogen

The Sveconorwegian orogen corresponds to the portion of Scandinavia affected by the Sveconorwegian orogeny at the end of the Mesoproterozoic (Figs. 1, 2; Berthelsen 1980). The Western Gneiss Complex, representing a basement window in the Caledonides of western Norway, and Caledonian crystalline nappes of the Middle Allochthon affected by Sveconorwegian deformation are not discussed in this paper (Tucker et al. 1990; Bingen et al. 2001b; Skår & Pedersen 2003). Continental domains in the Sveconorwegian orogen are referred to as sectors, segments or terranes in the literature. We use the term terrane, in the sense recommended by the glossary of the American Geological Institute, i.e. a tectonically-bounded body of rock of regional extent, characterized by a geologic history different from that of contiguous terranes. The term has no connotation of an exotic origin, but suggests significant transport. In this context, we divide the Sveconorwegian orogen into one parautochthonous segment, the Eastern Segment, and two allochthonous terranes, the Idefjorden and Telemarkia terranes (Figs. 1, 2). As discussed later in this paper, Telemarkia consists of four sectors, namely the Telemark, Hardangervidda, Suldal and Rogaland-Vest Agder sectors. Internal divisions in the Rogaland-Vest Agder sector, as proposed by Duchesne et al. (1999), are not addressed in this paper. The Bamble-Kongsberg

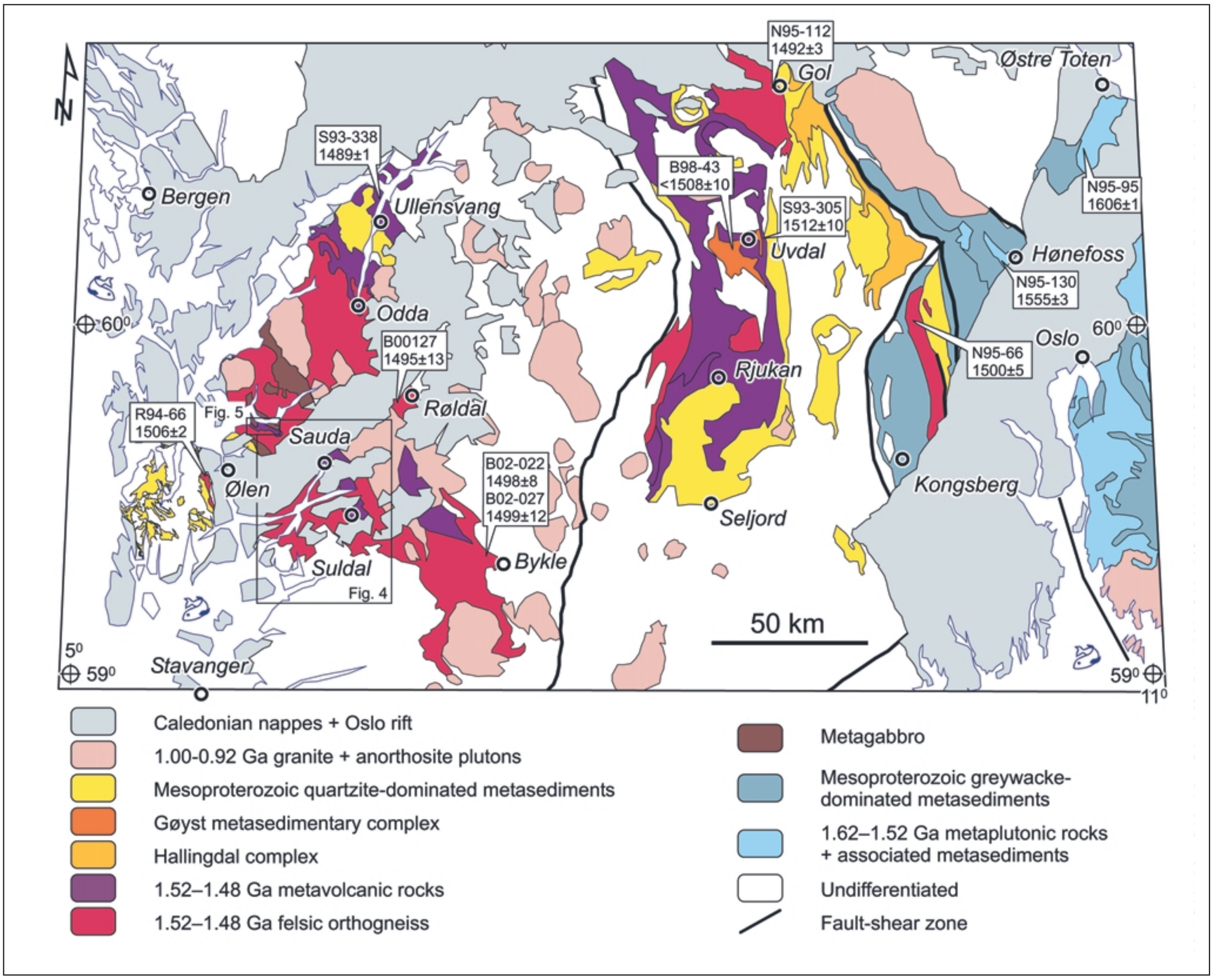

Fig. 3. Geological sketchmap of S Norway with a summary of sampling and results.

sector is interpreted in this paper as an early-Sveconorwegian collision zone between Telemarkia and the Idefjorden terrane (Fig. 1) and is described separately.

Eastern Segment

The easternmost continental domain of the Sveconorwegian orogen is historically called the Eastern Segment and is bounded to the east by the Sveconorwegian Frontal Deformation Zone (Figs. 1, 2; Wahlgren et al. 1994). It mainly consists of 1.80-1.64 Ga deformed granitoids (Table 7; Fig. 7A; Connelly et al. 1996; Larson et al. 1999; Christoffel et al. 1999; Söderlund et al. 1999, 2002), and is characterized by a distinctive late-Sveconorwegian high-pressure metamorphic overprint dated at 0.97 Ga (Möller 1998; Möller 1999; Johansson et al. 2001). The orthogneisses bear evidence for at least one pre-Sveconorwegian amphibolite-facies metamorphic event, associated with partial melting and leading to formation of metamorphic zircon in the 1.46-1.42 Ga interval (Christoffel et al. 1999; Söderlund et al. 2002). A minor volume of 1.40-1.38 Ga, 1.25-1.20 Ga granite plutonism is recorded (Table 7, Fig. 7A).

Idefjorden terrane

The Idefjorden terrane extends across the Phanerozoic Oslo rift. It is bounded by the Mylonite Zone to the east and by the Östfold-Marstrand and Åmot-Vardefjell Shear Zones to the west (Figs. 1, 2; Åhäll et al. 1998; Bingen et al. 2001a). An amphibolite-rich, banded paragneiss complex limits the terrane along the Åmot-Vardefjell Shear Zones. The terrane comprises greenschist- to amphibolite-facies tholeiitic to calc-alkaline magmatic suites and metagreywacke sequences (Åhäll et al. 1998; Brewer et al. 1998; Åhäll et al. 2000). Metavolcanic rocks include the 1643 ± 29 Ma Horred formation, 1614 ± 7 Ma Åmål formation, and 1615 ± 31 Ma Slemmestad metarhyolite (Table 8; Lundqvist & Skiöld 1993; Åhäll et al. 1995; Brewer et al. 1998; Andersen et al. 2004). Metaplutonic suites range in age from 1.62 to 1.52 Ga (Table 8; Fig. 7B; Connelly & Åhäll

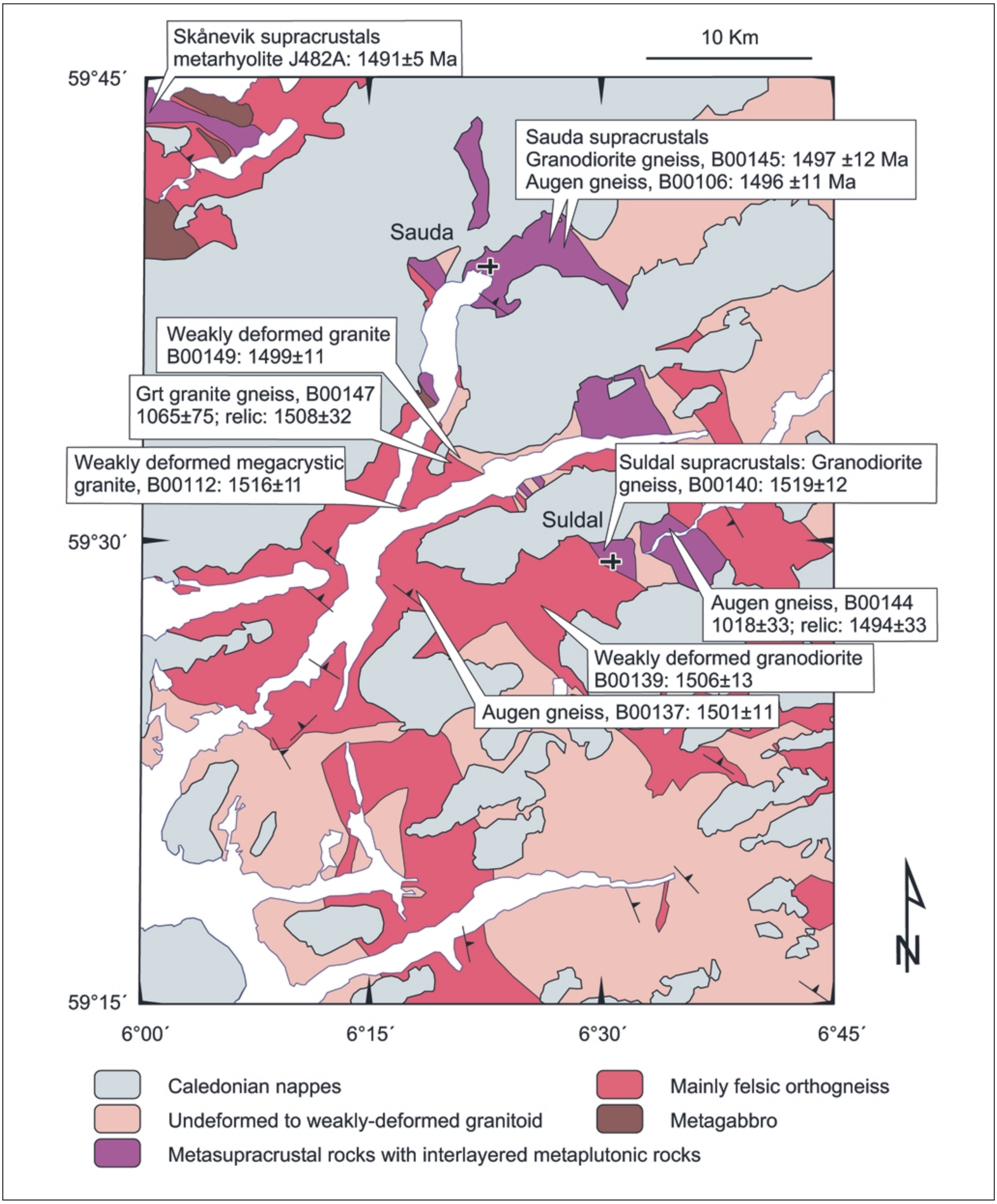

Fig. 4. Geological sketchmap of the Sauda-Suldal area with a summary of sampling and results. Map following Sigmond (1975).

1996; Brewer et al. 1998; Åhäll et al. 2000; Scherstén et al. 2000; Andersen et al. 2004; Nordgulen & Skår 2004). Geochronological data on two plutonic complexes situated west of the Oslo rift, are reported in Tables 1-2. These are the Vinflomyra granite gneiss giving an age of 1606 ± 2 Ma (sample N95-95, Figs. 3, 8A) and the Follum metapluton giving an age of 1555 ± 3 Ma (sample N95-130, Figs. 3, 8B). The Follum metapluton forms a foliated boudin parallel to the regional NW-SE structural trend. It ranges in composition from diorite to tonalite and has a low-K calc-alkaline signature typical of a primitive volcanic arc (Bingen et al. 2004). The voluminous Stora Le-Marstrand formation and correlative formations in Norway are made up of metagreywacke associated with mafic metavolcanic and plutonic rocks deposited at or after 1.58 Ga (Fig. 2; Åhäll et al. 1998; Bingen et al. 2001a). Two types of detrital zircon age distribution are recorded in the greywacke-dominated metasediments (Åhäll et al. 1998; Mansfeld & Andersen 1999; Bingen et al. 2001a; Andersen et al. 2004). One type is broad with modes between 2.0 and 1.55 Ga. The other type, recorded in turbidite sequences, is narrow with a mode between 1.66 and 1.53 Ga.

The Idefjorden terrane displays a specific plutonic suite at 1.34-1.32 Ga (Cornell & Austin Hegardt 2004), a poorly dated granite suite at 1.25-1.20 Ga, metasupracrustal rocks of the Dal group and late-Sveconorwegian 0.96-0.92 Ga granite plutons (Table 8, Fig. 7B).

Bamble-Kongsberg sector

The Bamble-Kongsberg sector forms a slightly warped belt between the Telemark sector and the Idefjorden terrane. It consists of amphibolite- to granulite-facies para- and orthogneiss complexes showing a strongly oriented SW-NE (Bamble) to N-S (Kongsberg) structural pattern (Starmer 1985). The sector is characterized by a distinctive early-Sveconorwegian 1.13-1.10 Ga high-grade metamorphism (Kullerud & Dahlgren 1993; Cosca et al. 1998). The oldest dated orthogneisses range in age between 1.57 and 1.52 Ga and show calc-alkaline signatures similar to coeval suites in the Idefjorden terrane (Table 9; Fig. 7C; Kullerud & Dahlgren 1993; Andersen et al. 2002b; Andersen et al. 2004). Younger orthogneisses are also reported. These include a 1500 ± 5 Ma granodiorite gneiss (the Veldstad gneiss fringing the Modum metasedimentary complex; sample N95-66; Tables 1, 2; Figs. 3, 8C) and a 1.46 Ga orthogneiss in Bamble (the Nelaug gneiss associated with Selås banded gneiss; de Haas et al. 2002). Two main types of metasedimentary complex are exposed. The first type commonly shows a banding parallel to regional structures and consists of metagreywacke-metapelite associated with amphibolite and felsic orthogneisses (Kongsberg complex, Selås Banded gneiss, Hisøy-Torungen complex; Starmer 1985; Knudsen et al. 1997, de Haas et al. 1999; 2002). The second type is dominated by quartzite and contains distinctive sillimanite-rich gneiss, orthoamphibole-cordierite gneiss, and calc-silicate gneiss (Modum, Kragerø and Nidelva complexes; Starmer 1985). Detrital zircon data constrain deposition of the metagreywacke-metapelite complexes in Bamble to be younger than 1.45 and 1.38 Ga (2 samples) and the quartzite complexes to be younger than 1.47 Ga (3 samples; Knudsen et al. 1997; Åhäll et al. 1998; de Haas et al. 1999; Bingen et al. 2001a). The Bamble-Kongsberg sector displays gabbro and granitoid metaplutons intruded between 1.20 and 1.15 Ga and late-Sveconorwegian granite plutons formed between 1.00 and 0.92 Ga (Table 9, Fig. 7C).

Telemark sector

The Telemark sector occurs to the west of the Åmot-Vardefjell and Saggrenda-Sokna shear zones and to the north-west of the Kristiansand-Porsgrunn shear zone (Figs. 1, 2). It consists of a large, greenschist- to epidote-amphibolite-facies supracrustal sequence with a total thickness exceeding 10 km, surrounded by amphibolite-facies gneiss complexes. In the low-grade region of central Telemark, stratigraphic relations and primary depositional structures are largely preserved (Dons 1960). The supracrustal sequence divides into three main packages, namely the 1.51 Ga Rjukan group, the Vindeggen group and an upper package coeval or younger than 1.17 Ga (Dahlgren et al. 1990b; Laajoki et al. 2002; Bingen et al. 2003; Andersen & Laajoki 2003). At the bottom of the sequence, the voluminous Rjukan group consists of felsic metavolcanic rocks (Tuddal fm), locally showing evidence for extrusive modes of deposition. The unconformably overlying Vindeggen

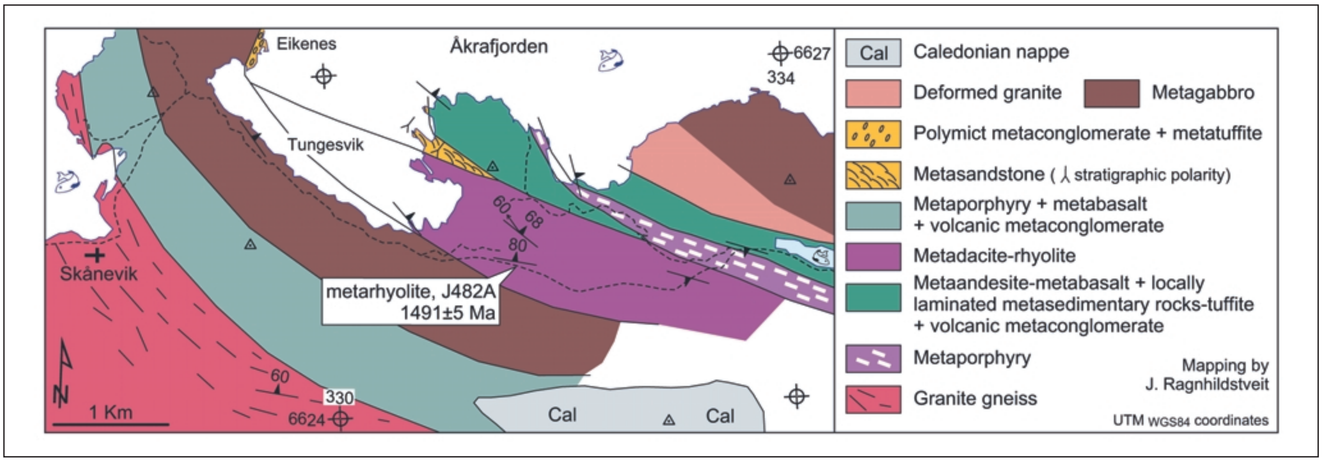

Fig. 5. Geological map of the coastal area in Skånevik, with sampling site.

group starts with mafic metavolcanic rocks (Vemork fm) interlayered with arkoses (Heddersvatnet fm), followed by a sequence dominated by fluviatile and shallow marine quartzite (Gausta fm) (Andersen & Laajoki 2003).

A ca. 1510 Ma metarhyolite and a 1500 ± 2 Ma cros-scutting dyke constrain deposition of the Rjukan group south of the town of Rjukan (Dahlgren et al. 1990b). To the north of Rjukan, a right-way up, weakly deformed section exposed in the Uvdal area, provides a crystallization age of 1512 +10/-8 Ma for a megacrystic metarhyolite (sample S93-305; Tables 1, 2; Figs. 3, 8D). The Rjukan group is spatially associated with plutonic rocks (commonly gradual change in grain size between the two types of rocks). Two foliated plutons yield intrusion ages of 1509 +19/-3 Ma (Table 10; Grotte suite; Ragnhildstveit et al. 1994) and 1476 ± 13 Ma (Tinn granite; Andersen et al. 2002c). Deformation and metamorphic grade progressively increase towards the base of the Rjukan group. As a result, the nature of the base of the group is uncertain. The amphibolite-facies Gøyst metasupracrustal complex was regarded as a possible basement to the Rjukan group by Sigmond et al. (1997). However, detrital zircons in a sample collected in a bedded metasandstone sequence in this complex in the Uvdal area define a $^{207}Pb/^{206}Pb$ age relative probability curve with a main mode at 1508 ± 10 Ma (7 out of 20 crystals) and minor modes at 1.98, 1.83, 1.80, 1.75, 1.63 Ga (sample B98-43; Tables 1, 3; Figs. 3, 9A). The 1508 ± 10 Ma mode demonstrates that the sediment was partly sourced in a catchment coeval to the Rjukan group and thus can not represent a basement to this group. The sediments in the Gøyst complex are coeval or younger than 1.51 Ga and consequently are either a part of the Rjukan group or are younger. They possibly correlate with the Heddersvatnet formation situated in the lower part of the overlying Vindeggen group. In the Gol area, the Rjukan group grades into a gneiss complex. A sample of orthogneiss from this complex yields an intrusion age of 1492 ± 3 Ma (sample N95-112, Table 1, 2, Figs. 3, 8E), which is slightly younger that the Rjukan group. Along the Åmot-Vardefjell shear zone limiting the Telemark sector to the NE, the Hallingdal gneiss and quartzite complex is exposed (Fig. 3). A quartzite sample from this complex contains detrital zircons ranging from 3.13 to 1.71 Ga (Bingen et al. 2001a). The data indicate that this complex was deposited after 1.71 Ga and thus may represent a basement to the 1.51 Ga Rjukan group. A depositional age younger than 1.51 Ga is nevertheless possible.

The Telemark sector displays a voluminous continental 1.19-1.13 Ga bimodal plutonic and volcanic suite associated with clastic sediments (Fig. 2; Laajoki et al. 2002; Bingen et al. 2003). This suite is overlain by a cover of sediments younger than 1.12 Ga. The sector also contains a 1.03 Ga granodiorite suite and late-Sveconorwegian granite plutons (Table 10).

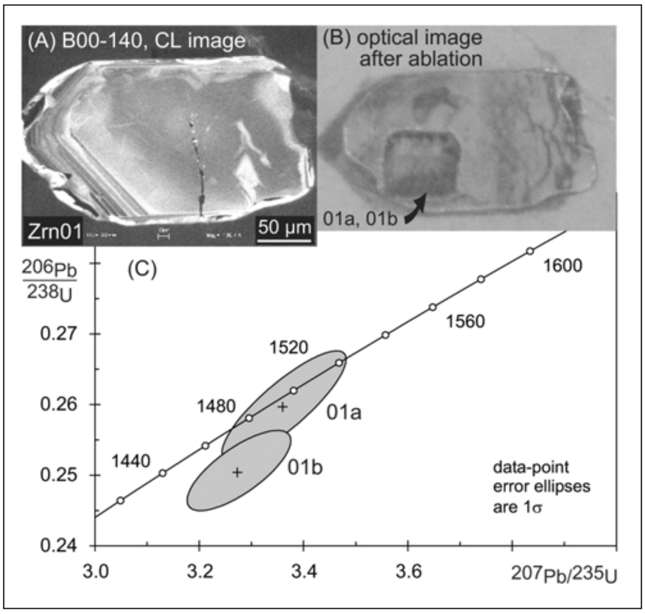

Fig. 6. (A) Cathodoluminescence image of zircon 01 of sample B00-140, showing a typical oscillatory zoning of magmatic origin. (B) Optical image of the same crystal after analysis, showing the size of a typical ablation pit. (C) Concordia diagram showing the two analyses from this pit.

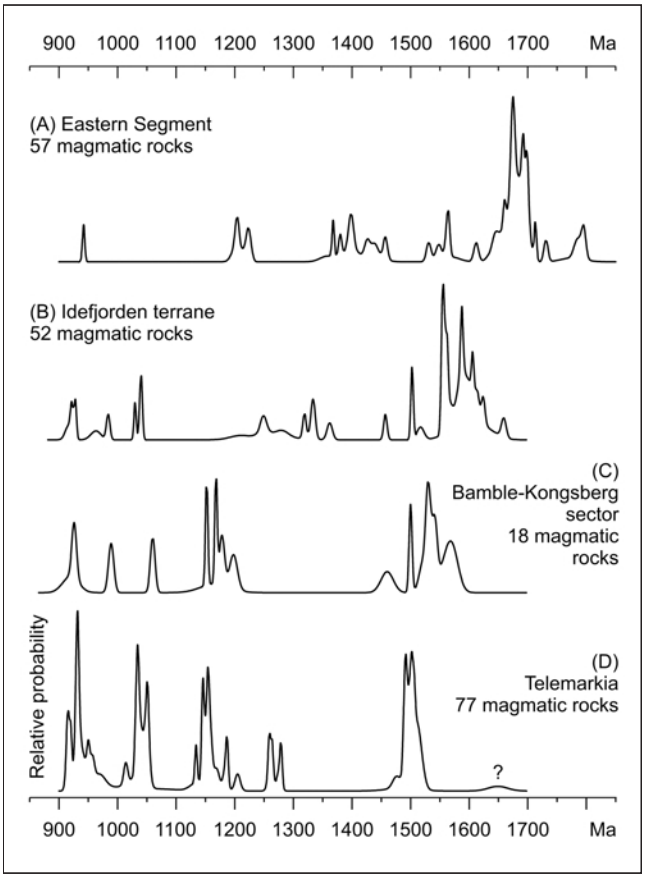

Fig. 7. Relative probability curves for magmatic events in the four main continental domains exposed in the Sveconorwegian orogen. (A) Eastern Segment, (B) Idefjorden terrane, (C) Bamble-Kongsberg sector and (D) Telemark, Hardangervidda, Suldal and Rogaland-Vest Agder sectors merged into one terrane called Telemarkia. The curves are based on dates from Tables 1, 7-10.

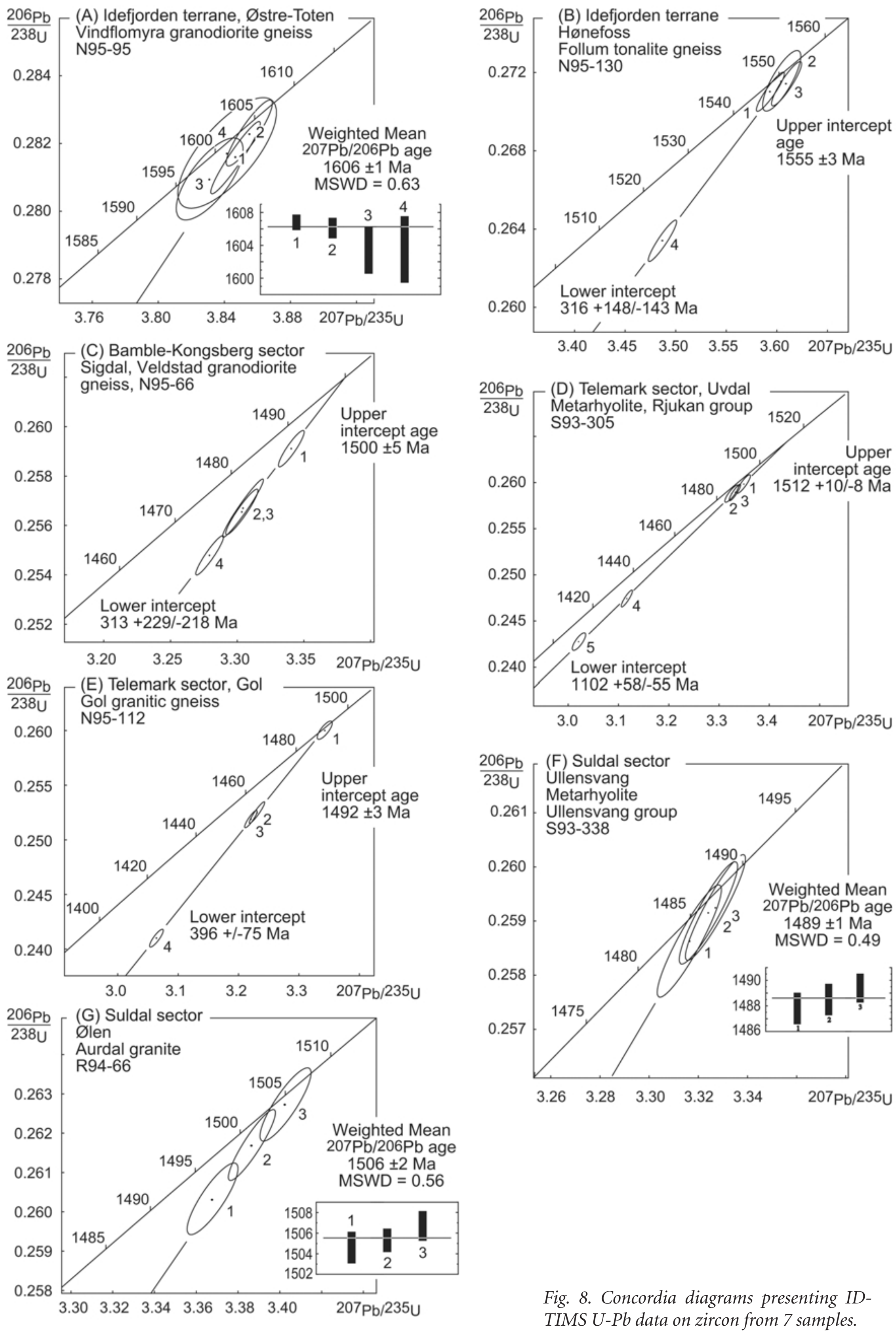

Fig. 8. Concordia diagrams presenting ID-TIMS U-Pb data on zircon from 7 samples.

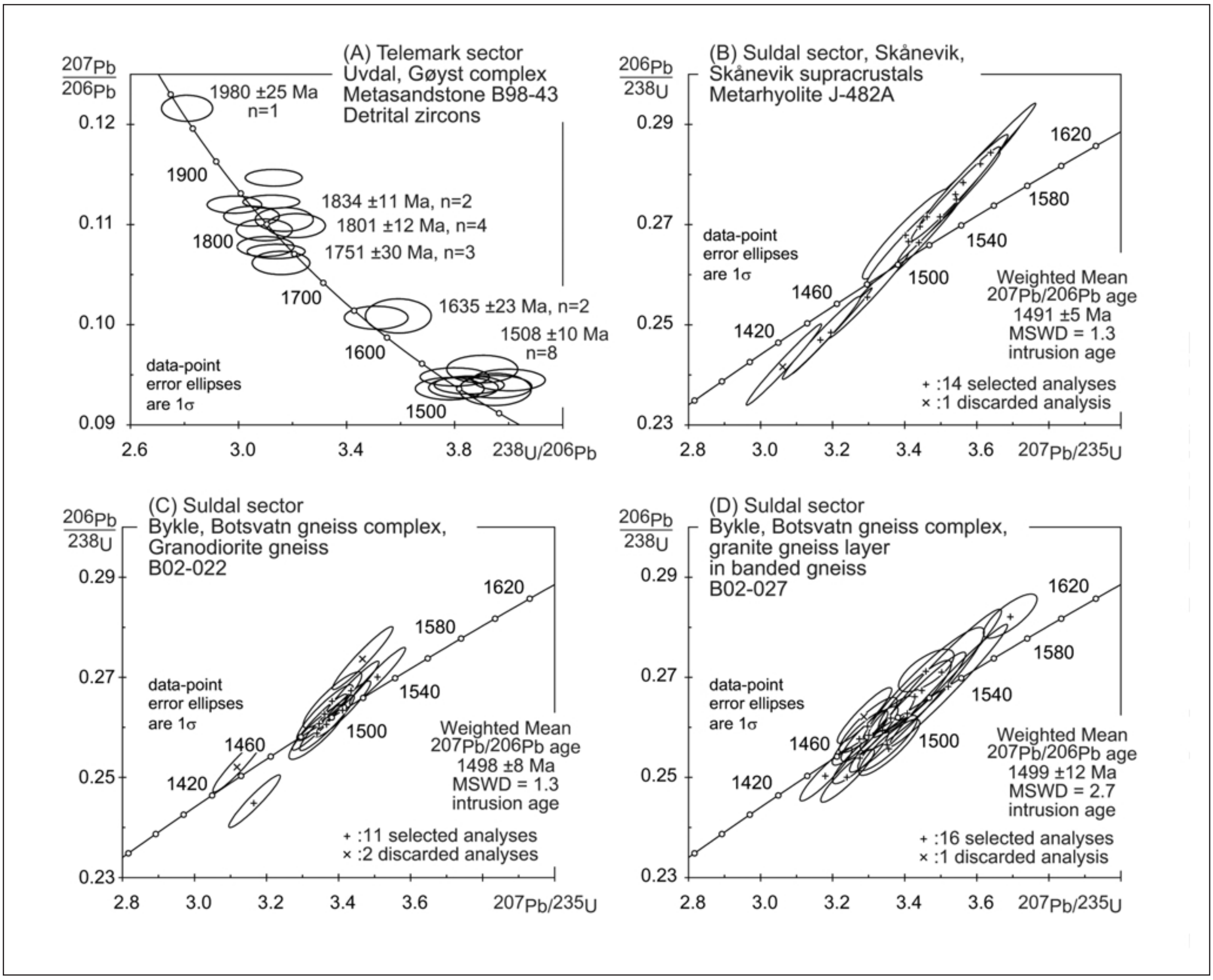

Fig. 9. Concordia diagrams presenting SIMS U-Pb data on zircon from 4 samples.

Hardangervidda sector

The Hardangervidda sector is exposed on the Hardangervidda plateau to the west of the N-S trending Mandal-Ustaoset fault and shear zone (Figs. 1, 2). It consists of an amphibolite-facies gneiss domain with a generally E-W structural pattern (Sigmond 1998). Orthogneisses are interlayered with metasedimentary rocks. The geochronology of these rocks is poorly established. One granite gneiss yields a poor upper intercept age of 1649 +33/-19 Ma (Mårsbrot granite gneiss; Table 10; Ragnhildstveit et al. 1994). Two samples of quartzofeldspathic gneiss analysed by Birkeland et al. (1997) and Sigmond et al. (2000) yield bi- or multimodal zircon age distributions that are difficult to interpret in terms of a single intrusion age. We suggest that these two samples represent paragneiss units. Detrital zircons in two samples of metasediment (Hettefjord and Festningsnut groups) range in age between 3.25 and 1.54 Ga. They constrain deposition of the sedimentary rocks to be younger than 1.54 Ga and attest to the presence of an active Palaeoproterozoic to Archaean catchment area during the Mesoproterozoic (Bingen et al. 2001a).

Suldal sector

To the southwest of the Hardangervidda plateau, the crust is made up of alternating orthogneiss and metasupracrustal complexes characterized by a SE-NW structural pattern and greenschist- to epidote-amphibolite-facies metamorphism (Sigmond 1978, 1998; Torske 1982). We use the name Suldal sector for this domain.

In the Ullensvang area (Fig. 3), supracrustal rocks of the Ullensvang group comprise, in stratigraphic ascending order, andesitic to dacitic metatuff (Kinsarvik fm), metarhyolite with minor metabasalt (Jåstad fm), quartzite (Aga fm), conglomerate (Jonstein fm), and carbonate-bearing micaschist and metaarkose (Vendevatn fm) (Torske 1982). A fine-grained (50-100 µm) platy metarhyolite of the Jåstad formation yields an extrusion age of 1489 ± 1 Ma (sample S93-338; Tables 1, 2; Figs. 3, 8F). This age constrains deposition of the lower part of the Ullensvang group. The base of the Ullensvang group is not defined as the supracrustal rocks show increased deformation and grade into a gneiss complex to the southwest (Torske 1982). An augen gneiss sample

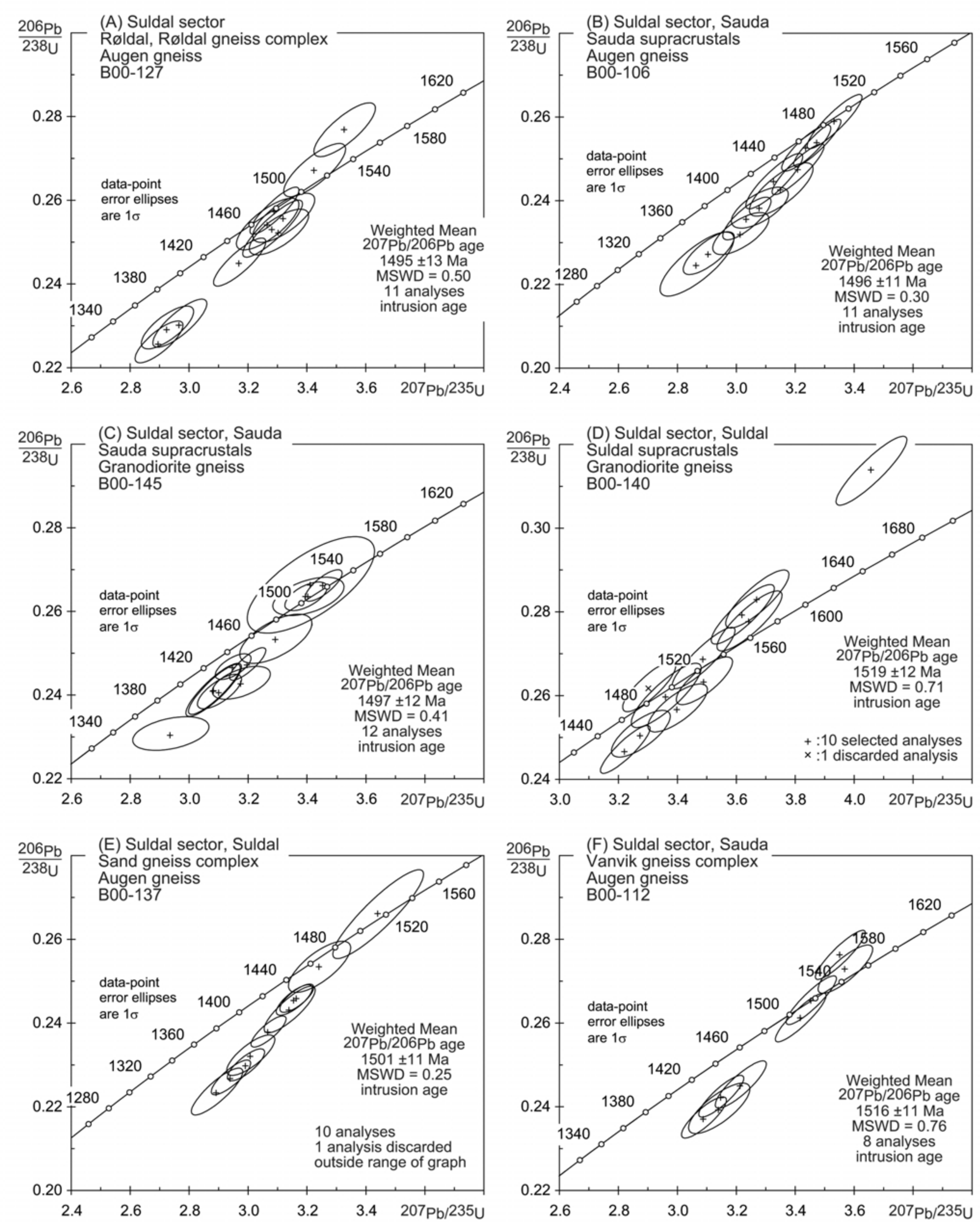

Fig. 10. Concordia diagrams presenting LA-ICP-MS data on zircon from 10 samples.

from a highly deformed section (strong lineation and foliation parallel to regional NW-SE structural pattern, occurrence of 1-10 m layers of amphibolite parallel to foliation) in the Røldal valley yields an age of 1495 ± 13 Ma for magmatic activity in this gneiss complex (sample B00-127; Tables 1, 5; Figs. 3, 10A). This age confirms a previous date of 1480 ± 60 Ma based on a whole-rock Rb-Sr errorchron for protolith formation in the Røldal valley (Berg 1977).

In the Skånevik area (Fig. 5; Mortensen 1942), a thin belt of weakly deformed metavolcanic rocks ranges in composition from basalt to andesite to rhyolite. The metavolcanic rocks are interlayered with metastandstone, metatuffite, metaconglomerate and metagabbro. A sample of a weakly deformed fine-grained (50-100 µm) metarhyolite flow in the centre of the belt provides an extrusion age of 1491 ± 5 Ma (sample J-482A; Tables 1, 4; Fig. 9B). Along strike, in the Sauda-Suldal area (Fig. 4), a supracrustal belt is made up of intensely deformed, fine-grained rocks interpreted as metavolcanic rocks interlayered with subordinate metaplutonic rocks (Sigmond 1978). The rocks commonly have an intermediate andesite-dacite composition. The best estimate for the timing of magmatic activity in the Sauda supracrustals is provided by an augen gneiss layer giving an age of 1496 ± 11 Ma (sample B00-106; Tables 1, 5; Fig. 10B) and a weakly-deformed granodiorite gneiss boudin giving an age of 1497 ± 12 Ma (samples B00-145; Tables 1, 5; Fig. 10C). The supracrustal rocks exposed in Suldal are coeval to marginally older than the ones exposed in Sauda. An intensely deformed (strong lineation) granodioritic gneiss interlayered with metarhyolite provides an age of 1519 ± 12 Ma (sample B00-140; Tables 1, 5; Fig. 10D). The gneiss complex surrounding the supracrustal rocks consists of variably deformed granodiorite to granite gneiss (Fig. 4). The gneiss complex and the supracrustal rocks are conformable. Fine-grained rocks interpretable as metavolcanic rocks are common in the gneiss complex. Three samples of this gneiss complex, namely an augen gneiss (sample B00-137), a weakly deformed K-feldspar megacrystic granite gneiss (sample B00-112) and a weakly deformed granodiorite (sample B00-139), provide overlapping intrusion ages

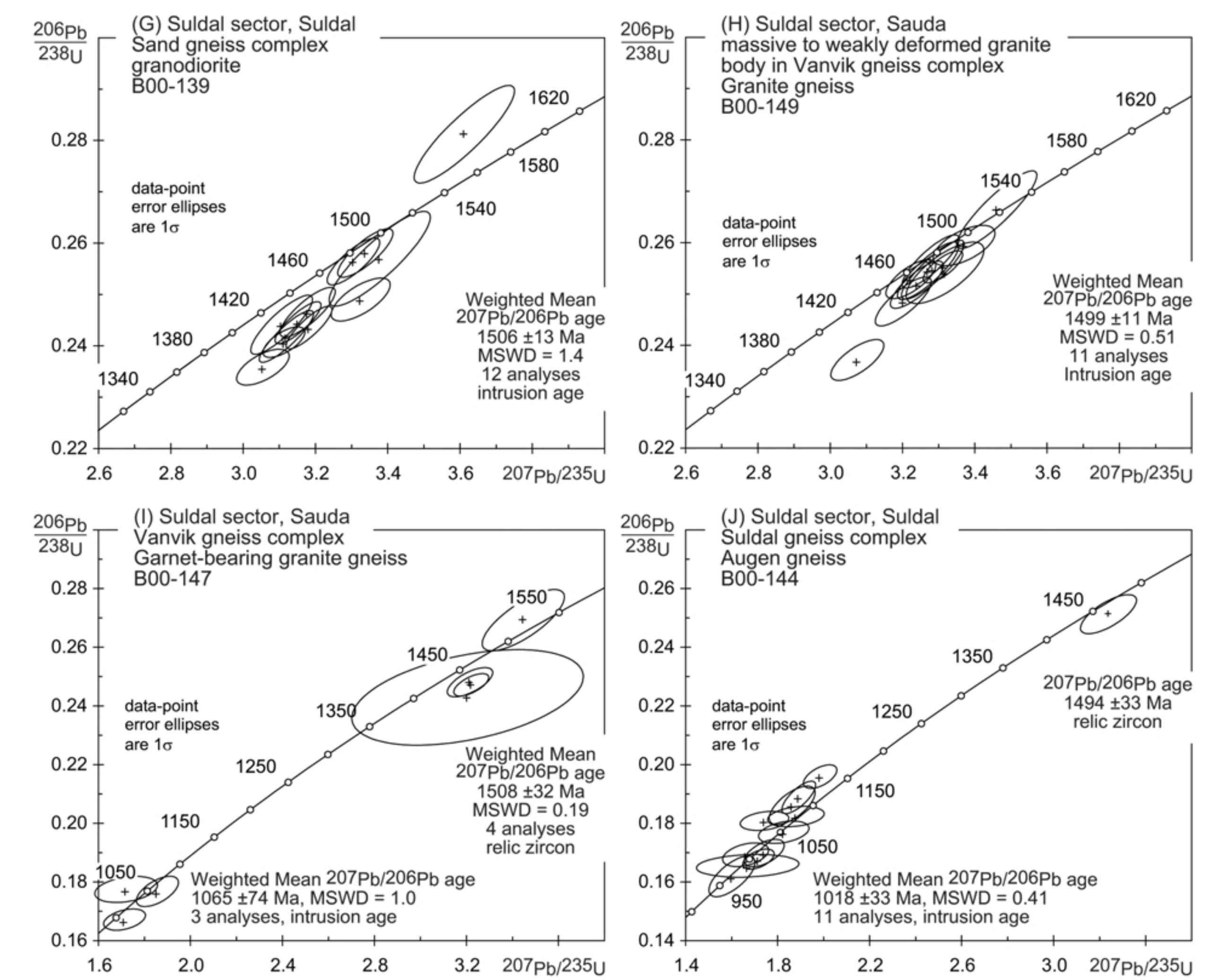

Fig. 10. cont.

of 1501 ± 11 Ma, 1516 ± 11 Ma and 1506 ± 13 Ma (Tables 1, 5; Fig. 10E-G). A sample from a more than 5 km-wide unit of weakly deformed to massive granite, showing a gradual contact to the gneiss complex (increasing fabric toward the contact) and showing plutonic textures in the centre of the unit, gives a similar age of 1499 ± 11 Ma (samples B00-149; Tables 1, 5; Fig. 10H). A sample of weakly deformed granite in the Ølen area, west of Sauda, yields an intrusion age of 1506 ± 2 Ma (sample R94-66, Tables 1, 2, Figs. 3, 8G). Two additional samples define imprecise Sveconorwegian intrusion ages of 1065 ± 74 and 1018 ± 33 Ma (samples B00-147 and B00-144; Tables 1, 5; Figs. 10I, J). These two samples contain zircon xenocrysts with ages of 1508 ± 32 and 1494 ± 33 Ma. One of these (B00-147) is a leucocratic garnet-bearing rock collected in an inhomogeneous outcrop in the gneiss complex, and probably corresponds to a granitic melt of local origin. Although imprecise, the two Sveconorwegian dates on foliated units demonstrate that the main regional NW-SE trending structural pattern in the Suldal-Sauda area is Sveconorwegian in age, in accordance with conclusions by Stein & Bingen (2002).

In the Bykle-Nesflaten area (Fig. 3), the Grjotdokki-Nesflaten supracrustal rocks are dominated by fine-grained rocks of intermediate composition, interpreted as metaandesite-dacite (Sigmond 1978). These rocks are spatially associated and interlayered with metabasalt, metarhyolite and metaconglomerate. The common banding of the supracrustal rocks and stretching of the conglomerate attest to important deformation. Zircon was not successfully recovered from a metadacite sample. Two samples of granodiorite and granite gneiss with augen texture were collected in the directly surrounding and conformable Botsvatn gneiss complex in the Bykle area. One of the two samples is a layer in a highly sheared banded gneiss (Fig. 11). The two samples yield ages of 1498 ± 8 Ma and 1499 ± 12 Ma (samples B02-022 and B02-027; Tables 1, 4; Figs. 9C, D). They provide an estimate for the timing of plutonic activity in the gneiss complex.

The Suldal sector displays a 1.27-1.21 Ga bimodal volcanic suite associated with metasediments (Sæsvatn-Valldal supracrustal sequence; Table 10; Bingen et al. 2002; Brewer et al. 2004). This supracrustal sequence overlies discordantly the 1.50 Ga Røldal gneiss complex. The Suldal sector also displays large, massive, late-Sveconorwegian granite plutons.

Rogaland-Vest Agder sector

At the southwestern end of the Sveconorwegian orogen, the intensity of Sveconorwegian metamorphism increases progressively, reaching granulite-facies in the vicinity of the Rogaland anorthosite complex (Tobi et

Fig. 11. Site of sample B02027 in the Botsvatn gneiss complex surrounding the Grjotdokki-Nesflaten supracrustals in the Bykle area. The outcrop is made of a highly sheared banded gneiss, with common boudinaged coarse-grained leucosomes parallel to or cutting the foliation. The sequence contains abundant fine-grained intermediate to mafic layers of possible volcanic origin. Felsic layers commonly contain cm-scale K-feldspar megacrysts, clearly linking them to a plutonic or sub-volcanic protolith. Sample B02027, is collected from the ca. 1.5 m thick layer of granite gneiss with a linear augen texture in the centre of the photo (collected in front of and away from field of view). This sample provides an estimate of 1499 ± 12 Ma for plutonic activity in the Botsvatn gneiss complex. The lithologies in the sampled section of the Botsvatn gneiss complex are similar to lithologies recorded in the nearby Grjotdokki-Nesflaten supracrustal rocks, except for the presence of a much larger volume of leucosome in the gneiss complex. The data available today are consistent with a near-coeval character for the Grjotdokki-Nesflaten metavolcanic rocks, although they do not demonstrate it. Representation of the Grjotdokki-Nesflaten supracrustals as 1.52-1.48 Ga rocks in Figs. 2-3 is thus a speculative extrapolation. The deformation recorded in this outcrop is regarded Sveconorwegian in age by the first author of this publication, though this interpretation requires demonstration.

al. 1985; Bingen & van Breemen 1998b; Möller et al. 2002). This amphibolite- to granulite-facies gneiss domain, called the Rogaland-Vest Agder sector, displays a SE-NW to N-S structural pattern. It consists of felsic orthogneisses and subordinate volumes of anatectic garnet-bearing gneiss, quartzite and mafic gneiss (Falkum 1985; Tobi et al. 1985). Few pre-Sveconorwegian U-Pb dates are recorded (Table 10). Available data include a poorly defined upper intercept age of 1.49 Ga for a granite gneiss (Pasteels & Michot 1975), and relic zircon cores at 1.58, 1.51 and 1.50 Ga in granulites (Möller et al. 2002, 2003).

The Rogaland-Vest Agder sector displays a significant magmatic suite at 1.18-1.15 Ga and voluminous Sveconorwegian plutonism between 1.05 and 0.92 Ga (Table 10). Late-Sveconorwegian plutonism includes the 0.93 Ga Rogaland anorthosite complex (Schärer et al. 1996).

Discussion

Timing of continental building

Figure 7 and Tables 1, 7-10 summarize available U-Pb dates on magmatic events in the Sveconorwegian orogen. The oldest cluster of peaks in the relative probability curve defines the main period of continental building in each domain (Fig. 7).

In the Eastern Segment, continental building took place between 1.80 and 1.64 Ga with a main magmatic pulse between 1.70 and 1.64 Ga (Fig. 7; Table 7). This magmatism largely overlaps the formation of the second and third phases of the Transscandinavian Igneous Belt, representing the foreland of the Sveconorwegian orogen (Åhäll & Larson 2000; Andersson et al. 2004). Consequently, the Eastern Segment is interpreted as a part of the Transscandinavian Igneous Belt that was underthrust, reworked and exhumed during the Sveconorwegian orogeny (Christoffel et al. 1999; Söderlund et al. 1999, 2002).

In the Idefjorden terrane, continental building is recorded between 1.66 and 1.52 Ga (Figs. 2, 7; Table 8). The geochemical and isotopic signatures of magmatic suites are typical for active margin settings (Brewer et al. 1998; Hageskov & Mørch 2000; Andersen et al. 2004). Magmatic rocks with a juvenile, low-K tholeiitic geochemical signature indicate that at least part of the Idefjorden terrane formed in a volcanic arc outboard of the Palaeoproterozoic continent, possibly in front of a back-arc basin (Åhäll et al. 1998; Brewer et al. 1998; Bingen et al. 2001a; Bingen et al. 2004). The occurrence of turbidite sequences with a narrow 1.66-1.53 Ga provenance age restricted to the volcanic arc, is consistent with this interpretation. Nevertheless, clastic zircons in

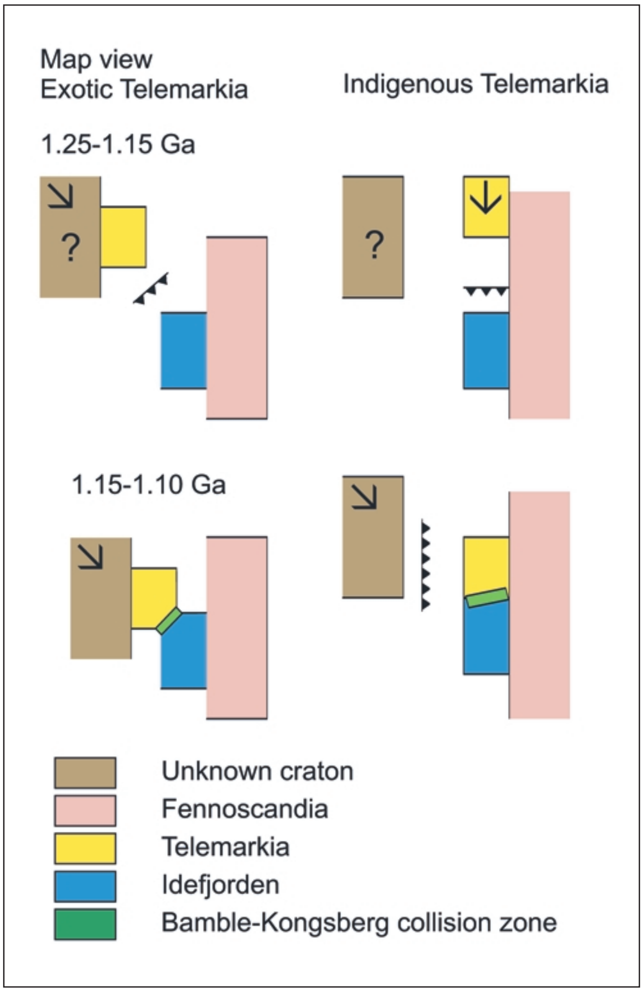

Fig. 12. Two possible models for terrane assembly at the onset of the Sveconorwegian orogeny. One model features Telemarkia attached to an unknown craton (exotic Telemarkia) and the other to Fennoscandia (indigenous Telemarkia). Colour coding follows Fig. 1. See text for more explanations. After 1.10 Ga, oblique (sinistral) convergence (1.10-0.97 Ga) and final extension (0.97-0.92 Ga) produced the final geometry pictured in Fig. 1. The Eastern Segment is not pictured in the model as it developed at the end of the Sveconorwegian orogeny by underthrusting of the Fennoscandia basement.

the 2.0-1.55 Ga range recorded in some metasediment samples suggest a continental margin setting with sources in the volcanic arc itself and in an evolved Palaeoproterozoic continent, probably Fennoscandia, behind the arc (Andersen et al. 2004). The Idefjorden terrane is interpreted as a composite and increasingly mature arc formed between 1.66 and 1.52 Ga at the margin or near the margin of Fennoscandia (Andersen et al. 2004; Nordgulen & Skår 2004). Formation of the Idefjorden terrane included accretion of juvenile oceanic arcs to the continent between 1.66 and 1.52 Ga. As argued by Cornell and Austin Hegardt (2004), no magmatic suite overlaps between the Idefjorden terrane and the Eastern Segment. The Idefjorden terrane can thus be alternatively interpreted as an exotic terrane assembled on Fennoscandia during the Sveconorwegian orogeny.

In the western part of the orogen, in the Telemark, Hardangervidda, Suldal and Rogaland-Vest Agder sectors, the main Mesoproterozoic magmatic event occurred during a comparatively short time interval between 1.52 and 1.48 Ga (Figs. 2, 7; Tables 1, 10). This event corresponds to a major continental growth event involving formation of widespread volcanic and plutonic complexes. Crust older than 1.52 Ga is not positively identified, although a ca. 1.8-1.7 Ga isotopic reservoir is allowed for by isotopic data on magmatic rocks (T_{DM} Nd and Hf model ages) (Menuge & Brewer 1996; Andersen et al. 2001; Andersen et al. 2002b). The geotectonic setting of 1.52-1.48 Ga continental building is uncertain. In the Suldal sector, preliminary geochemical data on abundant andesite-dacite and granodiorite lithologies suggest an active continental margin setting. In the Telemark sector, the bimodal character of volcanism (Tuddal fm vs. Vemork fm) and the A-type geochemical signature of the Rjukan group metarhyolite suggest a continental "within-plate" setting (Menuge & Brewer 1996; Sigmond et al. 1997). Differences in the style of magmatic suites thus suggest that continental building and reworking took place in different settings around 1.5 Ga in the different sectors and that the sectors were affected by relative motion after 1.5 Ga. The tight 1.52-1.48 Ga time interval for continental building in the west of the Sveconorwegian orogen nevertheless indicates that the Telemark, Hardangervidda, Suldal and Rogaland-Vest Agder sectors were geographically and genetically linked from the start and were part of a single piece of continent at the onset of the Sveconorwegian orogeny. We propose the name Telemarkia for this piece of continent. The widespread occurrence of Palaeoproterozoic and Archaean detrital zircons in sediment sequences associated with, or covering, the 1.52-1.48 Ga supracrustals implies that Telemarkia was situated in the vicinity or at the margin of an evolved craton during the Mesoproterozoic. Isotopic arguments (Andersen et al. 2001; Andersen et al. 2002b) and provenance analysis of detrital zircons (Knudsen et al. 1997; de Haas et al. 1999; Bingen et al. 2001a) are compatible with restoration of Telemarkia at the margin of Fennoscandia. Such a restoration is consistent with a simple geographic polarity for the 1.52-1.48 Ga magmatism at a presumed western active margin of Fennoscandia around 1.5 Ga. From the margin to the continent, this polarity is calc-alkaline magmatism in the westernmost Suldal sector, bimodal continental magmatism in the Telemark sector and 1.53-1.50 Ga rapakivi granite plutonism in the interior of the Fennoscandian craton (Ragunda suite in Sweden) (Åhäll et al. 2000; Bingen et al. 2001a). An origin of Telemarkia at the margin of an exotic craton is nevertheless permissible.

The Bamble-Kongsberg sector contains lithologies characteristic of both Telemarkia and the Idefjorden terrane (Figs. 2, 7; Tables 1, 9-10). The Bamble-Kongsberg sector shares with the Idefjorden terrane the 1.57-1.52 Ga calc-alkaline suite associated with greywacke metasediments (Andersen et al. 2004). It shares with Telemarkia 1.52-1.46 Ga granite plutonism, Mesoproterozoic quartzite-dominated platform sediment sequences and the 1.17-1.15 Ga suite of A-type granite-charnockite plutonism (Bingen et al. 2001a; Bingen et al. 2003). We interpret the Bamble-Kongsberg sector as an early-Sveconorwegian collision zone (1.13-1.10 Ga) between Telemarkia and the Idefjorden terrane.

Sveconorwegian assembly

The Sveconorwegian orogeny corresponds to the collision between Fennoscandia and an unknown craton at the end of the Mesoproterozoic. The Sveconorwegian orogen has a total width of ca. 500 km, including a ca. 100 km wide zone of reworking of cratonic Fennoscandia (Eastern Segment). An orogenic belt of this size can only be the product of a collision involving a major cratonic indenter. The Sveconorwegian orogeny includes assembly and imbrication of the terranes exposed in the orogen between 1.13 and 0.97 Ga. Telemarkia is the westernmost coherent continental domain exposed in the orogen (Figs. 1, 2). Two distinct assembly models are sketched in Fig. 12. One sketch features Telemarkia at the margin of Fennoscandia before the Sveconorwegian orogeny (indigenous Telemarkia), the other at the margin of another craton, not exposed in the orogen (exotic Telemarkia). In both models the Idefjorden terrane is part of the margin of Fennoscandia and the Bamble-Kongsberg sector is regarded as the original collision zone between Telemarkia and the Idefjorden terrane. The main reasons for this interpretation are as follows. (1) The Bamble-Kongsberg sector was affected by the earliest recorded Sveconorwegian metamorphic overprint, namely, the 1.13-1.10 Ga medium pressure amphibolite- to granulite-facies overprint (Kullerud & Dahlgren 1993; Cosca et al. 1998; de Haas et al. 2002). (2) The Bamble-Kongsberg sector contains the youngest recorded undisputable Mesoproterozoic volcanic arc magmatic suite, namely, the 1.20-1.18 Ga tholeiitic gabbro to tonalite Tromøy suite (Knudsen & Andersen 1999; Andersen et al. 2004). This suite attests to the preservation of an oceanic volcanic arc in the middle of the orogen, and suggests closure of an ocean basin between Telemarkia and the Idefjorden terrane. (3) As argued earlier, the Bamble-Kongsberg sector contains lithologies characteristic of both the Idefjorden terrane and Telemark sector and can thus be considered as a mixture of rocks of different origins (Fig. 2). In both models of Fig. 12, convergence between Telemarkia and the Idefjorden terrane before 1.14 Ga is accommodated by subduction of oceanic floor below the Idefjorden terrane. The 1.19-1.13 Ga association of continental bimodal magmatism and sediments in Telemarkia indicates that Telemarkia was affected by continental extension (Basin and Range-type extension; Bingen et al. 2003) before the collision event. The structures and geometry along the Telemark-Bamble boundary are compatible with early-Sveconorwegian thrusting of the Bamble-Kongsberg sector over the Telemark sector (Starmer 1985; Andersson et al. 1996; Henderson & Ihlen 2004; Ebbing et al. subm). The cover of clastic sediments younger than 1.12 Ga over the Telemark sector, namely the Heddal group and Eidsborg formation (de Haas et al. 1999; Laajoki et al. 2002; Bingen et al. 2003) can be interpreted as an early-Sveconorwegian foreland basin related to formation of the Bamble-Kongsberg collision zone.

After 1.10 Ga, Sveconorwegian deformation propagated towards the foreland and hinterland to accommodate oblique (sinistral) convergence (Hageskov 1985; Park et al. 1991; Stephens et al. 1996). Telemarkia was affected by major deformation during this period. A detailed account of Sveconorwegian tectonics is beyond the scope of this paper. The last undisputable evidence for convergence in the orogen is provided by 972 ± 14 Ma eclogite-facies metamorphism in the Eastern Segment (Möller 1998; Johansson et al. 2001).

Both models proposed in Fig. 12 are permissible. The first model restoring Telemarkia to the margin of an exotic craton before the Sveconorwegian orogeny implies a collision event lasting 160 m.y. The second model restoring Telemarkia to the margin of Fennoscandia features two collisions with closure of an oceanic basin: a first collision between Telemarkia and the Idefjorden terrane (at 1.13-1.10 Ga) and a second collision between an exotic craton and Telemarkia (after 1.10 Ga). In that case, the second Sveconorwegian suture would lie offshore to the west or southwest of Rogaland.

Conclusions

Zircon U-Pb geochronological data presented in this study demonstrate that the main continental building event in the westernmost exposed domain in the Sveconorwegian orogen, namely the Telemark, Hardangervidda, Suldal and Rogaland-Vest Agder sectors, took place during a short time interval between 1.52 and 1.48 Ga. This result suggests that these sectors are genetically linked and part of the same continent at the onset of the Sveconorwegian orogeny. The name Telemarkia is proposed for this piece of continent. The Sveconorwegian orogeny can be pictured as polyphase imbrication of crust at the margin of Fennoscandia between 1.13 and 0.97 Ga, as a result of a collision involving Fennoscandia, Telemarkia and unknown exotic craton. The Bamble-Kongsberg sector is interpreted as an early-Sveconorwegian collision zone between Telemarkia and the Idefjorden terrane.

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Table 1. Summary of sampling and zircon U-Pb geochronological data sorted by age

Area	Unit (1)	Lithology	Deformation (2)	Sample	X (3)	Y (3)	Minerals (4)	Method	n tot (5)	n sel (5)	MSWD (6)	Age (Ma)	± 2σ	(7)	Fig. (8)
Magmatic rocks															
Idefjorden terrane															
Hønefoss	Follum	tonalite gneiss	medium	N95-130	568300	6673000	Amp, Bt, Ttn	ID-TIMS	4	4	U.I.	1555	3	intrusion	8B
Østre Toten	Vindflomyra	granodiorite gneiss	strong	N95-95	595600	6710900	Bt, Ttn, Ep		4	4	0.63	1606	1	intrusion	8A
Bamble-Kongsberg sector															
Sigdal	Veldstad	granodiorite gneiss	medium	N95-66	539300	6654300	Bt, Amp, Ep	ID-TIMS	4	4	U.I.	1500	5	intrusion	8C
Telemark sector															
Gol	Gol	granite gneiss	medium	N95-112	494100	6727800	Bt, Amp, Ttn	ID-TIMS	4	4	U.I.	1492	3	intrusion	8E
Uvdal	Rjukan gp	metarhyolite	weak	S93-305	493200	6678900	Bt, Ms	ID-TIMS	5	5	U.I.	1512	10	extrusion	8D
Suldal sector															
Suldal	Suldal	augen gneiss	medium	B00-144	361332	6598990	Bt, Ttn, Ep	LA-ICPMS	12	11	0.41	1018	33	intrusion	10J
										1		1494	33	relic	
Sauda	Vanvik	granite gneiss	medium	B00-147	348978	6604031	Bt, Ms, Grt, Ep	LA-ICPMS	7	3	1.0	1065	74	intrusion	10I
										4	0.19	1508	32	relic	
Ullensvang	Ullensvang gp	metarhyolite	weak	S93-338	369900	6695100	Bt, Ms, Ep	ID-TIMS	3	3	0.49	1489	1	extrusion	8F
Skånevik	Skånevik supra	metarhyolite	weak	J-482A	331550	6625250	Bt, Ms	SIMS	15	14	1.3	1491	5	extrusion	9B
Røldal	Røldal	augen gneiss	strong	B00-127	374822	6632511	Bt, Ep, Ttn	LA-ICPMS	11	11	0.50	1495	13	intrusion	10A
Sauda	Sauda supra	augen gneiss	strong	B00-106	355423	6616505	Bt, Ttn, Ep	LA-ICPMS	11	11	0.30	1496	11	intrusion	10B
Sauda	Sauda supra	granodiorite gneiss	weak	B00-145	356486	6615548	Bt, Amp, Ttn, Ep	LA-ICPMS	12	12	0.41	1497	12	intrusion	10C
Bykle	Botsvatn	granodiorite gneiss	strong	B02-022	401532	6584563	Bt, Amp, Ttn	SIMS	11	9	1.3	1498	8	intrusion	9C
Bykle	Botsvatn	granite gneiss	strong	B02-027	401374	6584548	Bt, Ttn	SIMS	17	16	2.7	1499	12	intrusion	9D
Sauda	Vanvik	granite gneiss	weak	B00-149	349902	6604087	Bt, Ep, Ttn	LA-ICPMS	11	11	0.51	1499	11	intrusion	10H
Suldal	Sand	augen gneiss	medium	B00-137	345552	6596393	Bt, Ttn	LA-ICPMS	11	10	0.25	1501	11	intrusion	10E
Suldal	Sand	granodiorite	weak	B00-139	353257	6594411	Amp, Bt, Ttn	LA-ICPMS	12	12	1.4	1506	13	intrusion	10G
Ølen	Aurdal	granite	weak	R94-66	314950	6607000	Bt, Ms	ID-TIMS	3	3	0.56	1506	2	intrusion	8G
Sauda	Vanvik	augen gneiss	weak	B00-112	345527	6600998	Bt	LA-ICPMS	8	8	0.76	1516	11	intrusion	10F
Suldal	Suldal supra	granodiorite gneiss	strong	B00-140	357548	6597318	Bt, Amp, Ep, Ttn	LA-ICPMS	11	10	0.71	1519	12	intrusion	10D
Metasediment															
Telemark sector															
Uvdal	Gøyst	metasandstone	medium	B98-43	483400	6679600	Bt, Ms, Grt	SIMS	21	8	0.91	1508	10	detrital	9A
										2		1635	23	detrital	
										3		1751	30	detrital	
										4		1801	12	detrital	
										2		1834	11	detrital	
										1		1980	25	detrital	

(1) gp: group; supra: supracrustals.
(2) Qualitative evaluation of the deformation of the rock following field and petrographic data.
(3) UTM WGS84 coordinates, zone 32.
(4) Diagnostic minerals: Amp: amphibole; Bt: biotite; Ms: muscovite; Ttn: titanite; Ep: epidote; Grt: garnet.
(5) n tot: total number of analyses; n sel: number of analyses selected for age calculation.
(6) MSWD: Mean Square Weighed Deviation obtained for weighted mean 207Pb/206Pb age calculation; U.I.: upper intercept age.; se Table 2 for decay constants.
(7) Interpretation of the nature of the event dated based on petrography of the rock and cathodoluminescence imaging of zircon; relic: zircon xenocrysts inherited from the source; detrital: detrital zircon clast.
(8) Figure presenting the concordia diagram

Table 2. ID-TIMS zircon U–Pb data.

	Fraction properties (1)	Wt. (μg) (2)	Concentrations Pb rad (ppm) (2)	U (ppm) (2)	Pb com (pg) (3)	Th/U (4)	Atomic ratios $^{206}Pb/^{204}Pb$ (5)	$^{207}Pb/^{206}Pb$ (6)	±σ	$^{207}Pb/^{235}U$ (6)	±σ	$^{206}Pb/^{238}U$ (6)	±σ	Age $^{207}Pb/^{206}Pb$ (Ma) (7)	±σ	Disc (%) (8)
N95-95, Vindflomyra granodioritic gneiss, Fig. 8A																
1	3gr,+75,pb,t-pr	11	36.1	117	1	0.57	15313	0.09908	5	3.84672	611	0.28158	44	1606.8	0.9	
2	3gr,+75,pb,t-pr	10	36.7	118	4	0.60	5408	0.09904	6	3.85506	571	0.28231	40	1606.1	1.2	
3	1gr,+75,pb,t-pr	3	32.8	106	2	0.59	2978	0.09890	15	3.83108	827	0.28095	50	1603.4	2.8	
N95-130, Follum tonalite gneiss, Fig. 8B																
1	8gr,+75,cl,c,s-pr	19	18.2	59	2	0.74	10877	0.09617	6	3.59361	566	0.27102	41	1551.1	1.2	0.8
2	6gr,+75,cl,c,s-pr	16	21.7	71	7	0.68	2717	0.09627	13	3.60478	771	0.27158	63	1553.0	2.6	0.5
3	8gr,+75,cl,c,s-pr	19	20.8	67	1	0.75	14398	0.09645	7	3.60957	606	0.27143	46	1556.5	1.4	0.6
4	15gr,-75,cl,c,s-pr	31	18.9	65	2	0.62	18223	0.09601	6	3.48688	571	0.26340	43	1547.9	1.1	4.2
N95-66, Veldstad granodiorite gneiss, Fig. 8C																
1	4gr,+75,c,tu,t-pr	4	167	639	2	0.28	25663	0.09351	5	3.34059	393	0.25911	30	1498.2	0.9	1.4
2	4gr,+75,pb,t-pr	10	151	574	5	0.33	20213	0.09327	5	3.30433	624	0.25670	48	1493.4	0.9	2.5
3	2gr,+75,pb,t-pr	10	106	405	11	0.32	6017	0.09357	5	3.30349	491	0.25655	38	1499.5	1.0	2.6
4	4gr,+75,pb,tu,t-pr	8	100	389	2	0.28	21579	0.09335	4	3.27935	426	0.25479	33	1495.0	0.9	3.4
S93-305, Rjukan group metarhyolite, Fig. 8D																
1	2gr,+75,cl,c,s-pr	8	31.4	111	2	0.57	9370	0.09347	7	3.34870	556	0.25984	41	1497.4	1.5	5.8
2	1gr,+75,cl,c,e,s-pr	5	31.9	115	2	0.49	6528	0.09318	8	3.32506	551	0.25880	38	1491.6	1.6	7.2
3	5gr,vpb-c,eq,e,pr	14	30	106	1	0.56	18886	0.09332	6	3.33149	460	0.25892	37	1494.4	1.2	7.0
4	6gr,cl,c,e,s-pr	9	26.6	100	1	0.53	14070	0.09135	6	3.11663	459	0.24744	37	1453.9	1.3	21.7
5	4gr,-75,cl,c,l-pr	9	20.4	77	6	0.59	1861	0.09027	10	3.02146	541	0.24277	39	1431.2	2.1	27.2
N95-112, Gol granite gneiss, Fig. E																
1	2gr,+75,pb,t-pr	5	28.4	104	2	0.43	5771	0.09323	9	3.34263	509	0.26003	34	1492.6	1.8	0.2
2	3gr,+75,pb,pr	7	50.4	191	1	0.39	14108	0.09265	5	3.23044	523	0.25250	40	1480.8	1.1	4.0
3	2gr,+75,pb,t-pr	4	52.5	234	2	0.39	15527	0.09242	6	3.22034	418	0.25190	32	1476.0	1.1	4.3
4	2gr,+75,pb,t-pt	4	66.4	260	3	0.46	5627	0.09222	7	3.06422	464	0.24100	33	1471.8	1.4	9.8
S93-338, Ullensvang group metarhyolite, Fig. 8F																
1	3gr,-75,cl,c,eu,pr	10	52.9	201	2	0.30	13606	0.09300	6	3.31634	535	0.25863	42	1487.8	1.2	
2	5gr,-75,cl,c,eu,pr,i	9	53.4	202	1	0.31	20995	0.09303	6	3.32410	484	0.25915	38	1488.5	1.2	
3	1gr,+75,cl,c,pr,i	10	52.9	201	1	0.30	32517	0.09307	5	3.32695	501	0.25925	40	1489.4	1.1	
R94-66, Aurdal granite, Fig. 8G																
1	3gr,+75,cl,c,eu,pr	9	30.4	115	2	0.28	6874	0.09383	8	3.36778	497	0.26033	37	1504.6	1.5	
2	10gr,+75,cl,eu,l-pr	18	57.1	217	2	0.24	40063	0.09386	5	3.38663	462	0.26170	37	1505.3	1.1	
3	10gr,cl-pb,c,pr	5	60.7	2929	5	0.26	4358	0.09393	7	3.40270	499	0.26273	38	1506.7	1.4	

(1) Cardinal number indicates the number of crystals analysed; all grains were selected from non-paramagnetic separates at 0° tilt at full magnetic field in Frantz Magnetic Separator; +75: size in mm; c: colourless; cl: clear; eq: equant; eu: euhedral; f: faceted; i: inclusion present; l-pr: long prismatic; pb: pale brown; pr: prismatic; s-pr: short prismatic; t-pr: tips from prism. (2) Concentrations are known to ±30% for sample weights of 30 μg and ±50% for samples <3μg. (3) Corrected for 0.0215 mole fraction common-Pb in the ^{205}Pb-^{235}U spike. (4) Calculated Th/U ratio assuming that all ^{208}Pb in excess of blank, common-Pb, and spike is radiogenic (λ 232Th=4.9475 10-11 y-1). (5) Measured, uncorrected ratio. (6) Ratio corrected for fractionation, spike, blank, and initial common-Pb (at the determined age from Stacey and Kramers, 1975). Pb fractionation correction = 0.094%/amu (±0.025% 1σ); U fractionation correction = 0.111%/amu (±0.025% 1σ). U blank = 0.2 pg; Pb blank < 10 pg. Absolute uncertainties (1σ) in the Pb/U and $^{207}Pb/^{206}Pb$ ratios calculated following Ludwig (1980). (7) $\lambda\ ^{238}U = 1.55125\ 10^{-10}\ y^{-1}$, $\lambda\ ^{235}U = 9.8485\ 10^{-10}\ y^{-1}$, $^{238}U/^{235}U = 137.88$. (8) Percent discordance along the discordia line shown in the corresponding concordia diagram, Fig. 8.

Table 3. SIMS U-Pb data on detrital zircons from a metasandstone sample

Sample/ analysis	U (ppm)	Th (ppm)	Pb (ppm)	Atomic ratios $^{206}Pb/^{204}Pb$ (1)	$^{207}Pb/^{206}Pb$ (2)	±σ (%)	$^{207}Pb/^{235}U$ (2)	±σ (%)	$^{206}Pb/^{238}U$ (2)	±σ (%)	rho (3)	Ages $^{207}Pb/^{206}Pb$ (Ma)	±σ	$^{206}Pb/^{238}U$ (Ma)	±σ	Disc. (%) (4)
B98-43, Gøyst complex in Uvdal, metasandstone, Fig. 9A																
20b	75	85	27	77700	0.09331	1.14	3.256	2.51	0.2531	2.24	0.89	1494	21	1454	29	97.3
15a	74	111	30	38625	0.09338	0.79	3.405	2.37	0.2644	2.24	0.94	1496	15	1512	30	101.1
08a	81	161	35	18836	0.09349	0.75	3.362	2.36	0.2608	2.24	0.95	1498	14	1494	30	99.8
20a	76	83	27	29121	0.09359	0.80	3.263	2.37	0.2529	2.23	0.94	1500	15	1453	29	96.9
05a	162	112	54	87260	0.09376	0.63	3.353	2.32	0.2594	2.23	0.96	1503	12	1487	30	98.9
01a	72	76	25	26688	0.09426	0.76	3.247	2.36	0.2499	2.23	0.95	1513	14	1438	29	95.0
06a	109	61	36	15528	0.09458	0.64	3.431	2.32	0.2631	2.23	0.96	1520	12	1506	30	99.1
11a	86	54	28	42937	0.09537	0.96	3.369	2.43	0.2562	2.23	0.92	1535	18	1471	29	95.8
13a	97	58	35	5534	0.10052	0.76	3.950	2.36	0.2850	2.24	0.95	1634	14	1617	32	99.0
19a	34	52	15	5627	0.10070	1,13	3.867	2.51	0.2785	2.24	0.89	1637	21	1584	32	96.8
03a	107	97	46	15783	0.10604	0.73	4.635	2.36	0.3170	2.24	0.95	1732	13	1775	35	102.5
18a	220	129	89	76923	0.10720	0.44	4.713	2.31	0.3189	2.27	0.98	1752	8	1784	35	101.8
07a	98	74	42	127910	0.10770	0.61	4.795	2.33	0.3229	2.25	0.96	1761	11	1804	35	102.4
04a	124	106	54	18155	0.10935	0.66	4.876	2.33	0.3234	2.23	0.96	1789	12	1806	35	101.0
02a	84	44	33	14100	0.10980	0.72	4.715	2.35	0.3114	2.24	0.95	1796	13	1748	34	97.3
12a	133	80	54	39746	0.11040	0.72	4.807	2.36	0.3158	2.25	0.95	1806	13	1769	35	98.0
09a	117	86	51	10778	0.11074	0.60	5.014	2.31	0.3284	2.23	0.97	1812	11	1831	36	101.0
17a	148	61	61	38139	0.11190	0.51	5.176	2.30	0.3355	2.24	0.98	1831	9	1865	36	101.9
16a	240	169	102	45228	0.11220	0.40	4.962	2.27	0.3208	2.23	0.98	1835	7	1793	35	97.7
10a	163	74	65	26254	0.11460	0.49	5.052	2.29	0.3197	2.23	0.98	1874	9	1788	35	95.5
14a	115	111	57	23057	0.12160	0.72	5.978	2.35	0.3566	2.24	0.95	1980	13	1966	38	99.3

(1) Measured ratio
(2) Ratio after correction for common Pb, using present-day average terrestrial isotopic composition following Stacey & Kramers (1975)
(3) Coefficient of error correlation
(4) Discordance along a discordia line to the origin: 100 *($^{206}Pb/^{238}U$ age)/($^{207}Pb/^{206}Pb$ age)

Table 4. SIMS U-Pb data on zircon from orthogneiss and metarhyolite samples

Sample/ analysis	U (ppm)	Th (ppm)	Pb (ppm)	Atomic ratios $^{206}Pb/^{204}Pb$ (1)	$^{207}Pb/^{206}Pb$ (2)	±σ (%)	$^{207}Pb/^{235}U$ (2)	±σ (%)	$^{206}Pb/^{238}U$ (2)	±σ (%)	rho (3)	Ages $^{207}Pb/^{206}Pb$ (Ma)	±σ	$^{206}Pb/^{238}U$ (Ma)	±σ	Disc. (%) (4)
J482A, Skånevik metarhyolite, Fig. 9B																
03a (5)	356	44	97	24414	0.09190	0.40	3.062	2.27	0.2416	2.23	0.98	1465	8	1395	28	95.2
15a	165	24	50	5519	0.09212	0.74	3.403	2.35	0.2679	2.23	0.95	1470	14	1530	30	104.1
12a	279	42	86	17376	0.09245	0.37	3.462	2.26	0.2716	2.23	0.99	1477	7	1549	31	104.9

13a	179	28	55	7943	0.09260	0.61	3.442	2.34	0.2696	2.26	0.97	1480	12	1539	31	104.0
09a	141	21	43	11064	0.09277	0.53	3.410	2.30	0.2666	2.24	0.97	1483	10	1524	30	102.7
08a	276	36	89	20333	0.09280	0.34	3.638	2.30	0.2844	2.27	0.99	1484	6	1613	33	108.7
16a	344	49	110	20272	0.09280	0.43	3.610	2.27	0.2821	2.23	0.98	1484	8	1602	32	108.0
06a	107	42	36	26824	0.09281	0.48	3.562	2.31	0.2784	2.26	0.98	1484	9	1583	32	106.7
04a	420	72	119	20585	0.09297	0.44	3.166	2.27	0.2470	2.23	0.98	1487	8	1423	29	95.7
14a	357	64	113	10872	0.09304	0.44	3.541	2.30	0.2760	2.26	0.98	1489	8	1571	32	105.5
01a	568	121	165	24426	0.09327	0.23	3.195	2.31	0.2484	2.30	1.00	1493	4	1430	30	95.8
02a	459	74	143	21464	0.09343	0.25	3.498	2.25	0.2715	2.23	0.99	1497	5	1549	31	103.5
11a	310	40	97	11444	0.09344	0.35	3.543	2.27	0.2750	2.24	0.99	1497	7	1566	31	104.6
07a	230	34	67	16650	0.09358	0.40	3.297	2.26	0.2555	2.23	0.98	1500	7	1467	29	97.8
05a	286	47	87	21538	0.09364	0.37	3.439	2.29	0.2664	2.26	0.99	1501	7	1522	31	101.4
B02-022, Botsvatn gneiss complex, granodiorite gneiss, Fig. 9C																
08a (5)	297	1	82	26522	0.08971	0.47	3.1183	1.49	0.25209	1.41	0.95	1419	9	1449	18	102.1
07a (5)	314	146	105	28532	0.09188	0.47	3.4665	1.60	0.27365	1.53	0.96	1465	9	1559	21	106.4
01a	138	56	44	12612	0.09248	0.73	3.3821	1.59	0.26522	1.41	0.89	1477	14	1517	19	102.7
12b	137	54	44	61958	0.09280	0.63	3.3609	1.54	0.26266	1.41	0.91	1484	12	1503	19	101.3
15a	457	279	151	48745	0.09308	0.47	3.3462	1.50	0.26074	1.42	0.95	1489	9	1494	19	100.3
13b	475	341	165	109487	0.09319	0.42	3.4349	1.48	0.26733	1.42	0.96	1492	8	1527	19	102.4
12a	135	53	43	22879	0.09361	0.75	3.3406	1.60	0.25882	1.41	0.88	1500	14	1484	19	98.9
06a	257	132	83	29983	0.09370	0.52	3.3666	1.50	0.26059	1.41	0.94	1502	10	1493	19	99.4
17a	345	70	97	32951	0.09373	0.47	3.1645	1.50	0.24487	1.42	0.95	1503	9	1412	18	94.0
03a	245	127	80	23416	0.09394	0.50	3.4114	1.49	0.26339	1.41	0.94	1507	9	1507	19	100.0
09a	297	44	91	33579	0.09422	0.42	3.5080	1.47	0.27003	1.41	0.96	1513	8	1541	19	101.9
B02-027, Botsvatn gneiss complex, granite gneiss, Fig. 9D																
03a (5)	158	45	49	18549	0.09094	0.58	3.2866	1.52	0.26213	1.41	0.92	1445	11	1501	19	103.8
19a	135	40	41	10865	0.09191	0.81	3.2972	1.63	0.26018	1.41	0.87	1466	15	1491	19	101.7
18a	265	84	78	18018	0.09213	0.56	3.1794	1.52	0.25029	1.41	0.93	1470	11	1440	18	97.9
13a	146	57	45	13960	0.09216	0.71	3.2742	1.58	0.25766	1.41	0.89	1471	13	1478	19	100.5
06b	149	45	47	7601	0.09251	1.04	3.4589	1.47	0.27117	1.04	0.71	1478	20	1547	14	104.7
12a	386	120	118	20608	0.09263	0.75	3.3006	1.60	0.25844	1.41	0.88	1480	14	1482	19	100.1
04a	396	124	123	27677	0.09311	0.66	3.3612	1.25	0.26182	1.07	0.85	1490	12	1499	14	100.6
16a	145	42	45	13728	0.09341	0.88	3.4275	1.96	0.26612	1.75	0.89	1496	17	1521	24	101.7
10a	83	35	27	12815	0.09352	1.23	3.4474	3.31	0.26736	3.07	0.93	1498	23	1527	42	101.9
11a	378	109	113	30453	0.09359	0.69	3.2757	1.57	0.25384	1.41	0.90	1500	13	1458	18	97.2
08a	161	46	51	30722	0.09374	0.79	3.5024	3.13	0.27100	3.03	0.97	1503	15	1546	42	102.9
15a	226	65	67	18913	0.09398	0.59	3.2397	1.53	0.25003	1.41	0.92	1508	11	1439	18	95.4
09a	205	61	64	33220	0.09403	0.83	3.4070	3.14	0.26279	3.03	0.96	1509	16	1504	41	99.7
22a	97	38	30	13721	0.09473	0.79	3.3509	1.64	0.25654	1.44	0.88	1523	15	1472	19	96.7
08b	155	48	52	66310	0.09496	0.84	3.6934	1.33	0.28210	1.04	0.78	1527	16	1602	15	104.9
23a	151	42	46	16452	0.09517	0.80	3.3558	1.66	0.25573	1.45	0.88	1531	15	1468	19	95.9
06a	290	127	95	118808	0.09523	0.59	3.5206	3.09	0.26814	3.03	0.98	1533	11	1531	41	99.9

(1) Measured ratio
(2) Ratio after correction for common Pb, using present-day average terrestrial isotopic composition following Stacey & Kramers (1975)
(3) Coefficient of error correlation
(4) Discordance along a discordia line to the origin: 100 *($^{206}Pb/^{238}U$ age)/($^{207}Pb/^{206}Pb$ age)
(5) Analysis discarded for mean age calculation.

Table 5. LA-ICPMS U-Pb data on zircon from orthogneiss samples

Sample/ analysis	Atomic ratios $^{207}Pb/^{206}Pb$ (1)	±σ	$^{207}Pb/^{235}U$ (1)	±σ	$^{206}Pb/^{238}U$ (1)	±σ	rho (2)	Ages $^{207}Pb/^{206}Pb$ (Ma)	±σ	$^{206}Pb/^{238}U$ (Ma)	±σ	Disc. (%) (3
B00-127, Augen gneiss, Røldal, Fig. 10A												
2a	0.0924	0.0011	3.53	0.07	0.277	0.004	0.80	1475	22	1576	22	106.8
17b	0.0926	0.0012	2.92	0.06	0.229	0.003	0.74	1479	25	1330	18	89.9
8	0.0927	0.0008	3.29	0.05	0.257	0.004	0.87	1481	15	1476	19	99.6
12	0.0929	0.0011	3.42	0.07	0.267	0.004	0.79	1487	23	1526	22	102.6
9	0.0931	0.0010	2.89	0.05	0.226	0.003	0.80	1489	21	1311	18	88.1
5	0.0932	0.0013	3.26	0.07	0.254	0.004	0.76	1491	27	1460	21	97.9
11	0.0934	0.0011	2.97	0.06	0.230	0.004	0.81	1497	23	1335	20	89.2
1	0.0938	0.0009	3.17	0.06	0.245	0.004	0.85	1505	19	1412	20	93.8
17a	0.0940	0.0009	3.28	0.07	0.253	0.005	0.88	1509	19	1454	23	96.3
4	0.0942	0.0013	3.32	0.07	0.256	0.004	0.74	1512	27	1467	20	97.1
2b	0.0950	0.0013	3.30	0.07	0.252	0.004	0.72	1528	26	1450	19	94.9
B00-106, Augen gneiss, Sauda, Fig. 10B												
12	0.0925	0.0016	2.86	0.08	0.225	0.005	0.79	1477	34	1306	27	88.4
8b	0.0927	0.0012	2.90	0.06	0.227	0.003	0.76	1482	25	1320	18	89.1
5a	0.0927	0.0009	3.13	0.06	0.245	0.004	0.88	1482	19	1410	23	95.2
7a	0.0929	0.0008	3.23	0.06	0.253	0.004	0.85	1485	17	1452	19	97.7
2b	0.0933	0.0007	3.33	0.06	0.259	0.004	0.90	1494	15	1484	22	99.4
5b	0.0934	0.0010	3.03	0.05	0.236	0.003	0.81	1496	20	1364	18	91.1
2c	0.0935	0.0006	3.27	0.05	0.254	0.004	0.91	1498	13	1458	19	97.3
7b	0.0937	0.0015	3.08	0.06	0.238	0.003	0.66	1503	29	1377	17	91.7
8a	0.0940	0.0008	3.21	0.06	0.247	0.004	0.90	1509	15	1425	21	94.5
11	0.0942	0.0014	3.15	0.07	0.243	0.004	0.77	1511	27	1400	22	92.6
3	0.0942	0.0014	3.01	0.06	0.232	0.003	0.69	1513	28	1345	17	88.9
B00-145, granodiorite gneiss, Sauda, Fig. 10C												
4	0.0924	0.0025	2.94	0.09	0.230	0.003	0.39	1475	51	1337	14	90.6
2	0.0926	0.0009	3.15	0.04	0.247	0.002	0.65	1479	18	1421	11	96.1
3	0.0927	0.0009	3.08	0.06	0.241	0.004	0.87	1482	19	1392	22	93.9
15	0.0927	0.0008	3.08	0.06	0.241	0.004	0.88	1483	17	1392	21	93.9
11	0.0929	0.0028	3.41	0.14	0.266	0.008	0.69	1485	57	1522	39	102.5
7	0.0934	0.0010	3.39	0.05	0.264	0.002	0.62	1496	21	1508	12	100.8
13	0.0935	0.0010	3.10	0.05	0.241	0.003	0.71	1497	21	1390	14	92.8
9	0.0936	0.0019	3.40	0.08	0.264	0.003	0.50	1501	39	1508	16	100.5
6	0.0938	0.0007	3.20	0.04	0.247	0.003	0.83	1504	13	1424	13	94.7
8	0.0941	0.0007	3.45	0.04	0.266	0.003	0.78	1510	14	1521	13	100.8
14	0.0943	0.0018	3.29	0.08	0.253	0.004	0.63	1513	36	1455	20	96.2
5	0.0949	0.0016	3.17	0.06	0.243	0.003	0.53	1525	33	1401	14	91.8
B00-140, granodiorite gneiss, Suldal, Fig. 10D												
5b (4)	0.0915	0.0009	3.30	0.06	0.262	0.004	0.83	1457	19	1499	20	102.9
2a	0.0937	0.0008	4.06	0.08	0.314	0.005	0.90	1503	16	1760	27	117.1
1a	0.0938	0.0012	3.36	0.08	0.260	0.005	0.85	1505	23	1488	26	98.9
5c	0.0940	0.0009	3.62	0.07	0.279	0.005	0.87	1508	18	1588	24	105.3
5a	0.0940	0.0010	3.67	0.07	0.283	0.005	0.84	1509	20	1606	23	106.4
2b	0.0941	0.0008	3.49	0.07	0.269	0.005	0.90	1510	17	1534	25	101.6
5d	0.0947	0.0008	3.22	0.06	0.247	0.004	0.89	1522	15	1421	20	93.3
1b	0.0948	0.0013	3.27	0.07	0.250	0.004	0.74	1524	25	1441	19	94.5
4a	0.0951	0.0010	3.64	0.07	0.278	0.005	0.86	1531	20	1580	24	103.2
4b	0.0960	0.0012	3.40	0.07	0.257	0.004	0.76	1548	24	1473	20	95.1
3b	0.0961	0.0011	3.49	0.06	0.263	0.004	0.80	1550	21	1506	19	97.2
B00-137, augen gneiss, Sand, Fig. 10E												
1 (4)	0.0894	0.0008	2.30	0.04	0.186	0.003	0.85	1413	17	1101	14	77.9
9	0.0927	0.0013	3.24	0.07	0.253	0.004	0.74	1482	27	1456	21	98.2
12	0.0932	0.0008	3.15	0.04	0.245	0.002	0.77	1493	16	1415	13	94.8
2	0.0933	0.0007	3.16	0.04	0.246	0.002	0.77	1494	15	1417	12	94.9
16	0.0935	0.0007	3.07	0.04	0.238	0.002	0.82	1498	14	1375	13	91.8
14	0.0936	0.0009	3.14	0.06	0.243	0.004	0.84	1501	19	1403	19	93.5
13	0.0937	0.0012	3.44	0.10	0.266	0.007	0.90	1503	25	1521	36	101.2
8	0.0939	0.0010	2.89	0.06	0.223	0.004	0.85	1506	20	1299	20	86.3
5	0.0940	0.0011	3.01	0.05	0.232	0.003	0.77	1508	22	1345	17	89.2

Sample/ analysis	Atomic ratios $^{207}Pb/^{206}Pb$ (1)	±σ	$^{207}Pb/^{235}U$ (1)	±σ	$^{206}Pb/^{238}U$ (1)	±σ	rho (2)	Ages $^{207}Pb/^{206}Pb$ (Ma)	±σ	$^{206}Pb/^{238}U$ (Ma)	±σ	Disc. (%) (3
15	0.0940	0.0008	2.94	0.04	0.227	0.003	0.82	1508	16	1317	15	87.3
3	0.0944	0.0008	2.99	0.04	0.230	0.003	0.79	1516	16	1333	13	87.9
B00-112, augen gneiss, Vanvik, Fig. 10F												
9a	0.0932	0.0006	3.55	0.06	0.276	0.004	0.90	1492	13	1573	20	105.4
18b	0.0942	0.0008	3.15	0.05	0.242	0.003	0.86	1513	15	1398	17	92.4
22a	0.0944	0.0007	3.45	0.06	0.265	0.004	0.89	1515	14	1517	20	100.1
22b	0.0945	0.0008	3.09	0.05	0.237	0.003	0.84	1518	17	1371	17	90.4
7	0.0948	0.0009	3.57	0.06	0.273	0.004	0.82	1524	18	1555	20	102.0
18a	0.0949	0.0007	3.42	0.06	0.261	0.004	0.90	1525	14	1496	20	98.1
9b	0.0951	0.0008	3.21	0.06	0.245	0.004	0.87	1530	17	1413	20	92.3
15	0.0952	0.0013	3.14	0.07	0.239	0.004	0.77	1531	27	1383	21	90.3
B00-139, granodiorite, Sand, Fig. 10G												
9	0.0923	0.0009	3.10	0.06	0.244	0.004	0.86	1474	18	1406	20	95.4
12	0.0931	0.0011	3.61	0.09	0.281	0.006	0.89	1489	22	1598	32	107.3
8	0.0935	0.0008	3.30	0.05	0.256	0.003	0.81	1498	16	1471	16	98.2
5	0.0935	0.0007	3.15	0.04	0.244	0.003	0.84	1499	13	1408	14	94.0
4	0.0935	0.0008	3.18	0.05	0.246	0.003	0.83	1499	17	1419	17	94.7
6	0.0936	0.0007	3.12	0.05	0.241	0.003	0.88	1500	14	1394	18	93.0
15	0.0938	0.0008	3.34	0.05	0.258	0.003	0.81	1504	17	1479	16	98.4
2	0.0938	0.0009	3.11	0.04	0.240	0.002	0.66	1505	18	1389	10	92.3
1	0.0940	0.0012	3.05	0.05	0.235	0.002	0.63	1509	23	1363	12	90.3
3	0.0948	0.0007	3.18	0.04	0.243	0.003	0.85	1524	13	1403	14	92.1
13	0.0953	0.0013	3.38	0.09	0.257	0.006	0.87	1535	25	1473	32	96.0
10	0.0969	0.0012	3.32	0.05	0.249	0.003	0.69	1565	22	1432	14	91.5
B00-149, granite gneiss, Vanvik, Fig. 10H												
4	0.0924	0.0009	3.22	0.05	0.253	0.003	0.71	1477	19	1452	13	98.3
5	0.0927	0.0008	3.28	0.05	0.256	0.003	0.85	1483	16	1470	18	99.2
1	0.0932	0.0008	3.27	0.06	0.254	0.004	0.85	1492	17	1460	19	97.9
2	0.0933	0.0008	3.24	0.05	0.252	0.003	0.81	1495	17	1446	16	96.8
14	0.0935	0.0009	3.20	0.05	0.248	0.003	0.80	1498	18	1430	16	95.5
3	0.0935	0.0008	3.28	0.06	0.255	0.004	0.87	1498	16	1462	20	97.6
6	0.0941	0.0007	3.31	0.04	0.255	0.002	0.76	1510	13	1465	11	97.0
13	0.0941	0.0010	3.07	0.05	0.237	0.003	0.72	1511	21	1370	14	90.7
9	0.0942	0.0009	3.46	0.07	0.266	0.005	0.89	1512	19	1522	26	100.7
7	0.0942	0.0013	3.37	0.06	0.259	0.003	0.60	1512	25	1486	13	98.3
12	0.0947	0.0014	3.32	0.07	0.254	0.004	0.73	1522	27	1458	21	95.8
B00-147, garnet granite gneiss, Vanvik, Fig. 10I												
7	0.0704	0.0035	1.72	0.09	0.177	0.003	0.32	941	102	1049	16	111.4
4	0.0745	0.0024	1.71	0.06	0.166	0.002	0.41	1056	65	991	13	93.9
2	0.0763	0.0020	1.85	0.06	0.176	0.003	0.59	1103	53	1045	19	94.7
8	0.0927	0.0021	3.44	0.12	0.269	0.007	0.76	1482	42	1538	36	103.8
5	0.0939	0.0014	3.21	0.07	0.248	0.003	0.66	1506	29	1428	17	94.8
6	0.0944	0.0011	3.22	0.05	0.247	0.003	0.66	1516	22	1424	13	93.9
3	0.0956	0.0089	3.20	0.33	0.243	0.011	0.43	1540	177	1401	56	90.9
B00-144, augen gneiss, Suldal, Fig. 10J												
7	0.0699	0.0027	1.74	0.07	0.180	0.002	0.29	927	80	1068	12	115.3
11	0.0713	0.0026	1.66	0.07	0.169	0.003	0.40	966	74	1004	15	103.9
10	0.0719	0.0022	1.60	0.07	0.161	0.005	0.68	983	62	963	26	98.0
9	0.0726	0.0019	1.86	0.07	0.186	0.004	0.66	1004	54	1097	24	109.3
13	0.0727	0.0012	1.89	0.05	0.188	0.004	0.76	1005	34	1112	20	110.7
2	0.0733	0.0064	1.66	0.15	0.165	0.003	0.18	1022	178	983	15	96.2
8	0.0735	0.0015	1.98	0.05	0.195	0.003	0.56	1027	40	1151	14	112.0
5	0.0743	0.0017	1.71	0.05	0.167	0.002	0.52	1050	46	996	13	94.8
12	0.0745	0.0020	1.74	0.06	0.169	0.003	0.57	1054	54	1008	17	95.6
6	0.0748	0.0031	1.88	0.08	0.182	0.002	0.30	1064	83	1076	13	101.1
14	0.0750	0.0028	1.82	0.07	0.176	0.003	0.36	1067	75	1047	14	98.1
4	0.0933	0.0016	3.24	0.08	0.251	0.004	0.71	1494	33	1446	23	96.8

(1) Ratio corrected for common Pb, using mean terrestrial isotopic composition at 1500 Ma (Stacey & Kramers 1975)
(2) Coefficient of error correlation
(3) Discordance along a discordia line to the origin: 100 *(206Pb/238U age)/(207Pb/206Pb age)
(4) Analysis discarded for mean age calculation

Table 6. Monitoring of the accuracy of the LA-ICPMS U-Pb analytical method on zircon in 2002-2003 relative to ID-TIMS reference data

Method/ Date of analysis	ØS9914 Age (Ma) (1)	±2σ	n (2)	dev (%) (3)	Z4510 Age (Ma) (4)	±2σ	n (2)	dev (%) (3)	ØS99316 Age (Ma) (5)	±2σ	n (2)	dev (%) (3)	Larvik Age (Ma) (6)	±2σ	n (2)	dev (%) (3)
ID-TIMS	1797	±3			2700	±1			966	±3			294	±1		
LA-ICPMS																
27 Nov 02	1778	±22	5	-1.1					961	±27	8	-0.5				
10 Dec 02	1787	±19	4	-0.6												
12 Dec 02	1793	±17	10	-0.2	2688	±35	5	-0.4	962	±21	5	-0.4				
11 Apr 03	1783	±14	5	-0.8	2684	±72	3	-0.6								
05 May 03	1797	±23	6	0.0												
06 May 03	1787	±39	6	-0.6					967	±46	9	0.1				
12 May 03	1790	±20	4	-0.4									293	±1	2	-0.3
15 May 03 (7)	1793	±18	7	-0.2	2695	±19	6	-0.2	961	±36	7	-0.5				
21 May 03	1794	±16	4	-0.2									293	±1	4	-0.3
02 Jun 03	1814	±39	7	0.9												
04 Jun 03	1818	±15	4	1.2	2695	±20	6	-0.2								
06 Jun 03 (7)	1801	±25	8	0.2												
19 Jun 03	1787	±15	7	-0.6												
18 Nov 03	1799	±38	8	0.1												
01 Dec 03	1786	±17	8	-0.6												
04 Dec 03	1793	±24	11	-0.2												
Mean	1794			-0.2	2691			-0.4	963			-0.3	293			-0.3

(1) ØS-99-14, Sjona granite from Nordland, N Norway, ID-TIMS age by Skår (2002).
(2) n: number of analyses on distinct crystals
(3) Deviation in % relative to reference ID-TIMS value
(4) Z4510, rhyolite from the Northwest Territories, Canada, ID-TIMS age by Davis & Peterson (1998).
(5) ØS-99-316, porphyritic quartz syenite from Jølster pluton, W Norway, ID-TIMS age by Skår & Pedersen (2003).
(6) Pegmatite from the Larvik district, S Norway, ID-TIMS age by S. Dahlgren, unpublished data.
(7) Dates of analytical work for the samples presented in this study

Table 7. Selection of U-Pb dates on magmatic events in the Eastern Segment

Lithology, Sample	Mineral (1)	Age (Ma)		Reference
Riddaho rare-mineral pegmatite	Clm	942	±2	Romer and Smeds, 1996
Vaggeryd syenite, 83115	Zrn	1204	±6	Jarl, 2002
Görbjörnarp syenite	Zrn	1204	+14/-8	Hansen and Lindh, 1991
Gumlösa-Glimåkra granite, 84083	Zrn	1204	±16	Johansson, 1990
Vaggeryd syenite, RA195	Zrn	1222	±10	Ask, 1996
Vårgårda granite gneiss	Zrn	1224	±8	Berglund cited in Connelly et al., 1996
Torpa granite, TA1	Zrn	1359	±26	Andersson et al., 2002
Tjärnesjö granite, isotropic facies, Björshult	Zrn	1368	±4	Andersson et al., 1999
Torpa granite	Zrn	1380	±6	Åhäll et al., 1997
Tjärnesjö granite, veined facies, TJ25D	Zrn	1394	±11	Andersson et al., 1999
Stensjö granite pegmatite dyke, S4	Zrn	1399	+7/-6	Christoffel et al., 1999
Varberg charnockite-granite association, S8	Zrn	1399	+12/-8	Christoffel et al., 1999
Glassvik deformed pegmatite dyke	Zrn	1409	±20	Söderlund, 1996
Särdal granite pegmatite dyke, S3	Zrn	1426	+9/-4	Christoffel et al., 1999
Gåsanabbe mafic orthogneiss, S5	Zrn	1438	+12/-8	Christoffel et al., 1999
Gällared S deformed granite-aplite dyke	Zrn	1443	±26	Söderlund et al., 2002
Vråna deformed aplitic dyke, S3	Zrn	1457	±7	Connelly et al., 1996
Mölle granite gneiss, 84093	Zrn	1497	+47/-34	Johansson et al., 1993
Flackarp granite gneiss, 76314	Zrn	1531	±8	Johansson, 1990
Hinneryd granite gneiss, 8712	Zrn	1548	±10	Lindth, 1996
Åker metabasite	Zrn	1562	±6	Söderlund et al., 2004
Vaggeryd dolerite dyke, RA412	Zrn	1565	±5	Ask, 1996
Metadolerite dyke, CHW670-OK450	Bdl	1568	+30/-8	Wahlgren et al., 1996
Visbergen, aplitic dyke, S6	Zrn	1612	±8	Connelly et al., 1996
Vägasked grey gneiss, 85017	Zrn	1640	±16	Johansson et al., 1993
granodiorite Ammesjön 79112	Zrn	1645	±9	Welin, 1994
Steninge mafic dyke, Steninge, S2	Zrn	1654	±9	Christoffel et al., 1999
Visbergen, paleosome, S4	Zrn	1660	±5	Connelly et al., 1996
Karlstad metagranite, W1	Zrn	1661	±27	Söderlund et al., 1999
Särdal orthogneiss, paleosome, S1	Zrn	1664	±7	Christoffel et al., 1999
Hagshult granite, 83114	Zrn	1673	±19	Jarl, 2002
Trysil "tricolor" granite gneiss	Zrn	1673	±8	Heim et al., 1996
Borås tonalite, AA9637	Zrn	1674	±8	Scherstén et al., 2000
Forshaga grey granite gneiss, SWS2	Zrn	1674	+24/-19	Persson et al., 1995
Övre Fryken metagranite, W2	Zrn	1674	±7	Söderlund et al., 1999
Broby monzonite, E1	Zrn	1674	±7	Söderlund et al., 1999
Brustad augen gneiss, Br9602	Zrn	1674	±10	Alm et al., 2002
Mårdaklev granitic gneiss	Zrn	1676	±10	Söderlund et al., 2002
Filipstad granite gneiss, 604	Zrn	1676	±7	Lindth et al., 1994
Gällared N, veined gneiss	Zrn	1679	±13	Söderlund et al., 2002
Hagfors granite gneiss, 602	Zrn	1684	±13	Lindth et al., 1994
Dagsås unveined and veined orthogneiss	Zrn	1686	±14	Söderlund et al., 2002
Skene felsic orthogneiss, SE1	Zrn	1686	±11	Andersson et al., 2002
Zachrisdal quartz-monzonite gneiss, AL84030	Zrn	1688	±10	Persson et al., 1995
Torsby granite, DC9416	Zrn	1689	±12	Larson et al., 1999
Hesta granitoid suite, Lake Åsunden, S2	Zrn	1692	±3	Connelly et al., 1996
Rymmen gabbro, 2 samples	Zrn	1692	±7	Claeson, 1999
Porphyry, Nyhusen, TL9403	Zrn	1697	±8	Lundqvist and Persson, 1999
Gällared S orthogneiss	Zrn	1698	±12	Söderlund et al., 2002
South Härene, paleosome, S1	Zrn	1699	±3	Connelly et al., 1996
Quartz monzodiorite	Zrn	1699	±7	Stephens cited in Söderlund et al., 1999
Granite, Grå-Larsknipen, TL9406	Zrn	1702	±11	Lundqvist and Persson, 1999
Alvesta granite gneiss, 86011	Zrn	1713	±3	Johansson, 1990
Mo Tonalite	Zrn	1731	±7	Mansfeld, 2000
Granite gneiss	Zrn	1777	+38/-22	Welin cited in Söderlund et al., 1999
Filipstad granite, 82051	Zrn	1783	±10	Jarl and Johansson, 1988
Venjan porphyry, St. Kullsberget, TL9402	Zrn	1792	+10/-8	Lundqvist and Persson, 1999
Granite locally charnockitic	Zrn	1796	±7	Stephens cited in Söderlund et al., 1999

(1) Zrn: zircon, Clm: columbite, Bdl: baddeleyite, Mnz: monazite, Ttn: titanite, Urn: uraninite, Eux: euxenite.

Table 8. Selection of U-Pb dates on magmatic events in the Idefjorden terrane

Lithology, Sample	Mineral (1)	Age (Ma)		Reference
Hakefjorden norite, contact melt HAS96003	Zrn	916	±11	Scherstén et al., 2000
Bohus granite, pegmatite-aplite, 88102	Mnz	922	±5	Eliasson and Schöberg, 1991
Flå granite	Zrn	928	±3	Nordgulen et al., 1997
Göteborg dolerite, Tuve dyke	Bdl	935	±3	Hellström et al., 2004
Vinga porphyry	Zrn	963	±17	Åhäll and Schöberg, 1999
Skuleboda rare-mineral pegmatite	Clm	984	±6	Romer and Smeds, 1996
Högsbo rare-mineral pegmatite	Clm	1030	±1	Romer and Smeds, 1996
Timmerhult rare-mineral pegmatite	Clm	1039	±3	Romer and Smeds, 1996
Skantorp rare-mineral pegmatite	Clm	1041	±2	Romer and Smeds, 1996
Sandsjön granite gneiss, 78140	Zrn	1210	+36/-34	Welin et al., 1981
Segmon granite, SWS9	Zrn	1249	+10/-7	Persson et al., 1983
Raufoss granite gneiss	Zrn	1250	±22	Nordgulen et al., 1997
Bunketorp granite, 79023	Zrn	1279	±62	Welin and Samuelsson, 1987
Støvika granite gneiss, Einavatnet	Zrn	1280	+22/-14	Nordgulen et al., 1997
Ursand granite	Zrn	1319	±6	Piontek et al., 1998
Chalmers gabbro, felsic facies, DC9723	Zrn	1333	±8	Kiel et al., 2003
Hästefjorden granite	Zrn	1334	+7/-3	Piontek et al., 1998
Askim granite, 78170	Zrn	1362	±9	Welin and Samuelsson, 1987
Orust dyke swarm, Islandsberg dyke	Zrn	1457	±6	Åhäll and Connelly, 1998
Brevik gabbro	Zrn	1502	±2	Åhäll and Connelly, 1998
Stigfjorden granite	Zrn	1503	+3/-2	Åhäll and Connelly, 1998
Norstrand-Sørmarka granodiorite, TA121	Zrn	1517	±12	Andersen et al., 2004
Röseskär felsic dyke	Zrn	1553	±2	Connelly and Åhäll, 1996
Rivöfjorden layered gabbro	Zrn	1555	±2	Åhäll et al., 2000
Burö-Hällsö diorite	Zrn	1555	±2	Connelly and Åhäll, 1996
Förö granite dyke	Zrn	1558	±3	Åhäll et al., 2000
Länsmansgården granite	Zrn	1559	±2	Åhäll et al., 2000
Bäckefors granite	Zrn	1562	±2	Åhäll et al., 2000
Gösta granite, SWS7	Zrn	1563	+32/-21	Persson et al., 1983
Hisingen granite	Zrn	1563	±2	Åhäll et al., 2000
Midtskog tonalite, TA116	Zrn	1567	±8	Andersen et al., 2004
Feiring quartz diorite, Ø3	Zrn	1574	±17	Andersen et al., 2004
Idala tonalite	Zrn	1584	±15	Åhäll et al., 1995
Bjørkelangen granodiorite, TA118	Zrn	1585	±18	Andersen et al., 2004
Bua gneiss, TK1-TK2	Zrn	1585	±11	Andersson et al., 2002
Rönnäng tonalite	Zrn	1587	±3	Connelly and Åhäll, 1996
Uddevalla granodiorite, 76267	Zrn	1587	±36	Welin et al., 1982
Stenkyrka granite	Zrn	1588	±5	Connelly and Åhäll, 1996
Racken red syeno-granite gneiss, DC972	Zrn	1590	±14	Larson et al., 1999
Harnäs gneiss, Hn96093	Zrn	1595	+24/-17	Alm et al., 2002
Racken quartz monzodiorite gneiss, DC9413	Zrn	1596	±11	Larson et al., 1999
Tistedal granodiorite, Ø1	Zrn	1599	+15/-16	Andersen et al., 2004
Lerum granite, 76263	Zrn	1603	±40	Welin and Samuelsson, 1987
Stora Lundby granodiorite, mesosome 9701b	Zrn	1605	±10	Scherstén et al., 2004
Höjen tonalite, SWS8	Zrn	1609	+35/-25	Persson et al., 1983
Åmål fm, Tösse porphyry	Zrn	1614	±7	Lundqvist and Skiöld, 1993
Slemmestad metarhyolite, 01/25	Zrn	1615	±31	Andersen et al., 2004
Åmål granodiorite, 77018	Zrn	1616	±24	Welin et al., 1982
Olstorp ultramafic intrusion, contact melt OD16	Zrn	1624	±6	Scherstén et al., 2000
Horred fm, Mjösjö dacite	Zrn	1643	±29	Åhäll et al., 1995
Horred fm, dacite	Zrn	1659	+8/-6	Connelly and Åhäll, 1996

(1) Zrn: zircon, Clm: columbite, Bdl: baddeleyite, Mnz: monazite, Ttn: titanite, Urn: uraninite, Eux: euxenite.

Table 9. Selection of U-Pb dates on magmatic events in the Bamble-Kongsberg sector

Lithology, Sample	Mineral (1)	Age (Ma)		Reference
Herefoss granite	Zrn	920	+16/-27	Andersen et al., 2002 a
Herefoss granite, 107	Ttn	926	±8	Andersen, 1997
Grimstad granite	Zrn	989	±9	Kullerud and Machado, 1991
Gloserheia pegmatite	Eux	1060	+8/-6	Baadsgaard et al., 1984
Gjeving metacharnockite	Zrn	1152	±2	Kullerud and Machado, 1991
Levang granitic gneiss dome, Southern part	Zrn	1167	±50	O'Nions and Baadsgaard, 1971
Hovdefjell metacharnockite	Zrn	1168	±2	Råheim unpublished
Tromøy complex, Hisøy tonalite, HGG	Zrn	1178	±9	Andersen et al., 2004
Tromøy gneiss complex, 4 samples	Zrn	1198	±13	Knudsen and Andersen, 1999
Nelaug gneiss	Zrn	1460	±21	de Haas et al., 2002
Jomås granodiorite, JOM	Zrn	1522	±14	Andersen et al., 2004
Bingen metadacite gneiss, 01/19	Zrn	1529	±7	Andersen et al., 2004
Snarum granodiorite, HFG	Zrn	1534	+9/-8	Andersen et al., 2004
Flosta charnockitic gneiss	Zrn	1542	±8	Kullerud and Machado, 1991
Justøy tonalite, Justøy, JUS	Zrn	1557	±24	Andersen et al., 2004
Justøy tonalite, Homborsund, HOM	Zrn	1569	±23	Andersen et al., 2004
Gjerstadvatn tonalite, NES	Zrn	1572	±20	Andersen et al., 2004

(1) Zrn: zircon, Clm: columbite, Bdl: baddeleyite, Mnz: monazite, Ttn: titanite, Urn: uraninite, Eux: euxenite.

Table 10. Selection of U-Pb dates on magmatic events in Telemarkia

Lithology, Sample	(1)	(2)	Mineral - Age (Ma)		Reference
Rymteland pegmatite	R	Urn	914	±6	Pasteels et al., 1979
Egersund-Ogna anorthosite, margin 75-32	R	Bdl	915	±4	Schärer et al., 1996
Vehuskjerringa granite, 0724061	T	Ttn	918	±7	Andersen et al., 2002 a
Tellnes dyke, ilmenite norite, T2	R	Zrn	920	±3	Schärer et al., 1996
Egersund-Ogna anorthosite, EO1	R	Zrn	929	±2	Schärer et al., 1996
Farsund charnockite, PA70A	R	Zrn	930	ca.	Pasteels et al., 1979
Tellnes dyke, quartz mangerite, 849	R	Zrn	931	±5	Schärer et al., 1996
Hidra monzonorite, charnockite dyke	R	Zrn	931	±10	Pasteels et al., 1979
Helleren anorthosite, 75-65	R	Zrn	932	±3	Schärer et al., 1996
Åna-Sira anorthosite, 92-21	R	Zrn	932	±3	Schärer et al., 1996
Vehuskjerringa granite	T	Zrn	934	±5	Dahlgren et al., 1990 b
Vrådal granite, 081696-1	T	Mnz	939	±20	Andersen et al., 2002 a
Tovdal granite	T	Zrn	940	±10	Andersen et al., 2002 a
Bessefjell granite	T	Zrn	940	±19	Andersen et al., 2002 a
Lyngdal granodiorite, La68A-Pa69K	R	Zrn	950	±5	Pasteels et al., 1979
Holum granite, 98BN21D	R	Zrn	957	±7	Bingen et al., submitted
Sæbyggjenut granite	R	Zrn	959	+50/-32	Andersen et al., 2002 a
Byklom granite	S	Zrn	970	+14/-18	Andersen et al., 2002 a
Høvring granite	T	Zrn	971	+63/-34	Andersen et al., 2002 a
Knaben Mo ore, granitic gneiss, B01028	R	Mnz	1014	±7	Bingen et al., unpublished
Fennefoss augen gneiss	T	Zrn	1031	±2	Pedersen and Konnerup-Madsen, 2000
Mykleås diorite	T	Zrn	1034	±2	Pedersen and Konnerup-Madsen, 2000
Charnockite, NR19A	R	Zrn	1035	±6	Möller et al., 2002
Fennefoss augen gneiss, B613	T	Zrn	1035	+2/-3	Bingen and van Breemen, 1998 a
Rosskreppfjord granite	R	Zrn	1036	+23/-22	Andersen et al., 2002 a
Charnockite, NR17C	R	Zrn	1037	±16	Möller et al., 2002
Pegmatite leucosome, NR16A	R	Zrn	1039	±11	Möller et al., 2003
Augen gneiss, NR2B	R	Zrn	1039	±7	Möller et al., 2002
Grt migmatite gneiss, NR12E	R	Zrn	1046	±12	Möller et al., 2003
Feda augen gneiss suite, Mandal, B206	R	Zrn	1049	+2/-8	Bingen and van Breemen, 1998 a
Feda augen gneiss suite, Veggja, B642	R	Zrn	1051	+2/-8	Bingen and van Breemen, 1998 a
Feda augen gneiss suite, Feda, B113	R	Zrn	1051	+2/-8	Bingen and van Breemen, 1998 a
Feda augen gneiss suite, Liland, B195	R	Zrn	1051	+2/-4	Bingen and van Breemen, 1998 a
Morkheia monzonite suite, M220	T	Zrn	1134	±2	Heaman and Smalley, 1994
Gunnarstul granite gneiss	T	Zrn	1134	±21	Andersen et al., 2002
Heddal gp, Skogsåa porphyry, TA992	T	Zrn	1145	±4	Laajoki et al., 2002
Eiddal granite gneiss, N95-65	T	Zrn	1146	+/-5	Bingen et al., 2003
Hesjåbutind gabbro	T	Zrn	1146	±2	Dahlgren et al., 1990 a
Høydalsmo gp, Dalaå porphyry, 830KLN	T	Zrn	1150	±4	Laajoki et al., 2002
Haglebu granite gneiss, N95-113	T	Zrn	1153	±2	Bingen et al., 2003
Brunkeberg fm, porphyry, 903KLN	T	Zrn	1155	±2	Laajoki et al., 2002
Oftefjell gp, Ljosdalsvatnet porphyry, 902KLN	T	Zrn	1155	±3	Laajoki et al., 2002
Hidderskog metacharnockite, B308	R	Zrn	1159	±5	Zhou et al., 1995
Sørkjevatn fm, metarhyolite, B9825	T	Zrn	1159	+/-8	Bingen et al., 2003
Vennesla augen gneiss, B603	T	Zrn	1166	+61/-21	Bingen and van Breemen, 1998 a
Nore gp, Rødberg rhyodacite, B9840	T	Zrn	1169	±9	Bingen et al., 2003
Flåvatn granite gneiss	T	Zrn	1184	+7/-5	Dahlgren et al., 1990 b
Gjerstad augen gneiss, M5	T	Zrn	1187	±2	Heaman and Smalley, 1994
Drivheia granite gneiss, M200	T	Zrn	1205	±9	Heaman and Smalley, 1994
Trossovdal fm, Nyastøl metarhyolite	S	Zrn	1259	±2	Brewer et al., 2004
Trossovdal fm, Nyastøl metarhyolite, B9817	S	Zrn	1260	±8	Bingen et al., 2002
Breive gp, Hovden metarhyolite, B9824	S	Zrn	1264	±4	Bingen et al., 2002
Breive gp, quartz porphyry, B9818	S	Zrn	1275	±8	Bingen et al., 2002
Iveland-Gautestad metagabbro	T	Zrn	1279	±3	Pedersen and Konnerup-Madsen, 2000
Tinn granite, 0831962	T	Zrn	1476	±13	Andersen et al., 2002 c
Lyngdal granite gneiss, Pa66R	R	Zrn	1486	ca.	Pasteels and Michot, 1975
Rjukan Gp, Myrstul rhyolite dyke	T	Zrn	1502	±1	Dahlgren et al., 1990 b
Grotte suite, tonalite -quartz diorite	T	Zrn	1509	+19/-3	Ragnhildstveit et al., 1994
Rjukan Gp, Runhellohovet metarhyolite	T	Zrn	1510	ca.	Dahlgren et al., 1990 b
Mårsbrot granite gneiss	H	Zrn	1649	+33/-19	Ragnhildstveit et al., 1994

(1) T: Telemark sector, H: Hardangervidda sector, S: Suldal sector, R: Rogaland-Vest Agder sector
(2) Zrn: zircon, Clm: columbite, Bdl: baddeleyite, Mnz: monazite, Ttn: titanite, Urn: uraninite, Eux: euxenite.