Reaction of $[(Cp_2TiCH_3)(THF)^+][BPh_4^-]$ with Tripeptide Derivatives: Formation of Cationic (Peptide)titanocene Complexes

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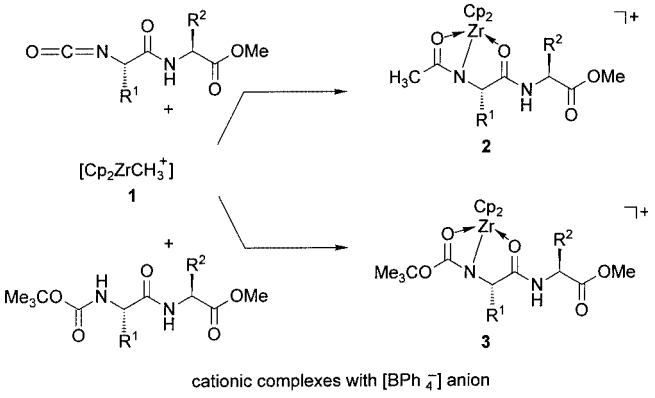
A series of Z- and Boc-protected tripeptide methyl esters [Z-/Boc-**5** to -**12**(pept)] was prepared using the amino acids glycine, alanine and valine. In both the alanine and the valine series a single glycine unit was introduced and its position inside the tripeptide framework was systematically varied. Reaction of these 16 tripeptide derivatives with the organometallic reagent $[Cp_2TiCH_3(THF)^+][BPh_4^-]$ (**13**) resulted in the formation of methyl(peptide)titanocene cation complexes that contained the strongly electrophilic $[Cp_2TiCH_3^+]$ cation moiety coordinated to a single carboxamide carbonyl oxygen atom. Mostly, the carbonyl oxygen atom of the central amino acid residue was specifically attached to yield the coordination products **5**–**12**(coord[7]). In a few specific cases, formation of the κO-adduct between the $[Cp_2TiCH_3^+]$ cation and the *N*-terminal amino acid moiety was also observed, especially in the cases of the *N*-terminal glycine derivatives. In one case we observed the migration of the $[Cp_2TiCH_3^+]$ group along the chain from the C4=O to the C7=O position. Subsequent thermally induced CH_4 elimination of the products **5**–**12**(coord) gave the cationic peptide chelate derivatives **5**–**12**(chel). These are characterized by the presence of a five-membered κ*O*,κ*N*-chelate with an anellated four-membered κ*N*,κ*O*-chelate. This is mostly centered around the central amino acid unit [products **5**–**12**(chel^B)], but in some cases the *N*-terminal amino acid, together with the *N*-terminal protective group, also forms this type of a stable peptide titanocene cation chelate complex [products **5**–**12**(chel^A)]. The selective formation of these series of (peptide)metallocene cation complexes was readily analyzed by means of their very characteristic ^1H and ^{13}C NMR spectra.

Introduction

Peptides represent interesting chiral ligand systems. Therefore, some of them have been used in organometallic chemistry and catalysis, although mostly such complexes derived from the middle or late transition metals are reported so far.[1−3] The usually rather oxophilic early metals, especially those of group 4 (and the f-elements), are not easily "tamed" to allow unrestricted bonding to the multifunctional oligopeptide frameworks. Some Cp group-4 metal complexes have found use in peptide synthesis.[4,5] A few (amino acid or peptide)cyclopentadienylzirconium complexes were previously described, and some catalytic features were reported;[6−10] *C*-terminal carboxylate-bonded amino acid derivatives were found useful in titanocene chemistry with regard to the development of novel antitumor pharmaceuticals.[11]

A cationic zirconocene complex of a dipeptide derivative (**2**) was first prepared by treatment of "Jordan's cation"[12] $[Cp_2ZrCH_3)(THF)^+][BPh_4^-]$ (**1a**) with the dipeptide isocyanate derivative. Addition of the $Zr-CH_3$ functionality to the *N*-terminal heterocumulene cleanly gave the $\kappa^2O,\kappa N$-chelate (dipeptide)zirconocene cation **2a** (see Scheme 1).[13] The typical metallatricyclic σ-framework of complex **2** was characterized by X-ray diffraction. The NMR spectroscopic analysis of **2** revealed typical spectroscopic features of this type of bonding, such as a strong shift of the $^{13}C4$ carbonyl resonance to larger δ values ($\Delta\delta \approx 8-10$ ppm) relative to the respective neutral noncoordinated peptides.[13] Treatment of the dipeptide derivative Boc-Ala-Val-OMe with **1** furnished the analogous zirconocene cation complex **3** (after loss of methane), that was characterized by an X-ray crystal structure analysis. It revealed the formation of a



Scheme 1

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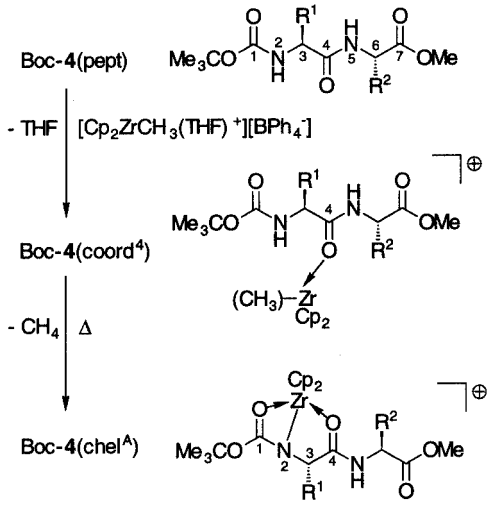
metallatricyclic structure analogous to **2** (see Scheme 1), that again exhibits very typical ^1H and ^{13}C NMR features.[14]

A series of experiments using different di- and tripeptide systems revealed that $[Cp_2ZrCH_3^+]$ was in all the cases first attached to the C4 carbonyl oxygen atom under kinetic control, followed by migration of the metallocene unit along the chain. Subsequent intramolecular NH deprotonation with loss of CH_4 usually led to the formation of complex **4**(chel) (with a few exceptions), which is the thermodynamic product in the series investigated[14] (see Scheme 2).



Scheme 2

We have now systematically examined the reaction of the titanium analog $[(Cp_2TiCH_3)(THF)^+][BPh_4^-]$[15] with peptides, employing two series of tripeptide derivatives (details see below), and found some similarities and some noteworthy differences in the formation of the cationic (peptide)titanocene complexes and in their chemical behavior.

Results and Discussion

Synthesis and Characterization of the Tripeptide Derivatives Employed in this Study

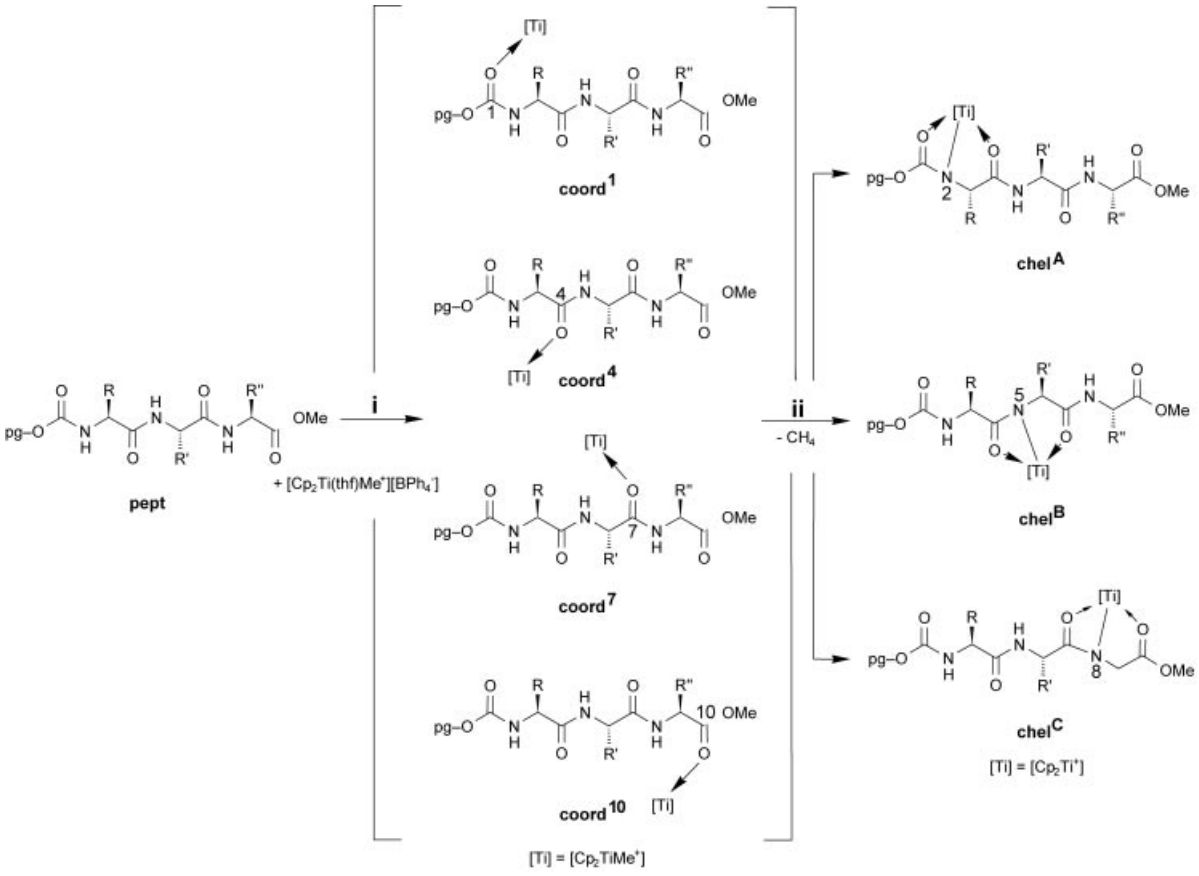
We have used two series of tripeptides in this study. The first involved a systematic combination of the natural amino acids glycine (Gly) and alanine (Ala) with a variation of the two *N*-terminal protecting groups benzyloxycarbonyl (Z)[16] and *tert*-butoxycarbonyl (Boc);[17] the *C*-terminal carboxylic acid was protected by a methyl ester group in each case. A single Gly amino acid was moved from the *N*-terminus through the center position to the *C*-terminus, and we used the corresponding $(Ala)_3$ systems for comparison. The Z-protected systems were prepared from the commercially available Z-dipeptide acids, to which the corresponding amino acid methyl esters were coupled using the IIDQ method.[18] The Boc-protected systems were synthesized in a similar way, although, the respective Boc-protected dipeptides were prepared by a variation using DCC.[19] In this way the eight tripeptide derivatives Z-**5**(pept) (= Z-Gly-Ala-Ala-OMe) to Boc-**8**(pept) (= Boc-Ala-Ala-Ala-OMe) were obtained[20] (for a compilation see Table 3).

The series of eight glycine- and valine-containing tripeptides Z-**9**(pept) (= Z-Gly-Val-Val-OMe) to Boc-**12**(pept) (= Boc-Val-Val-Val-OMe) were prepared analogously (for details see the Exp. Sect. and Table 3).

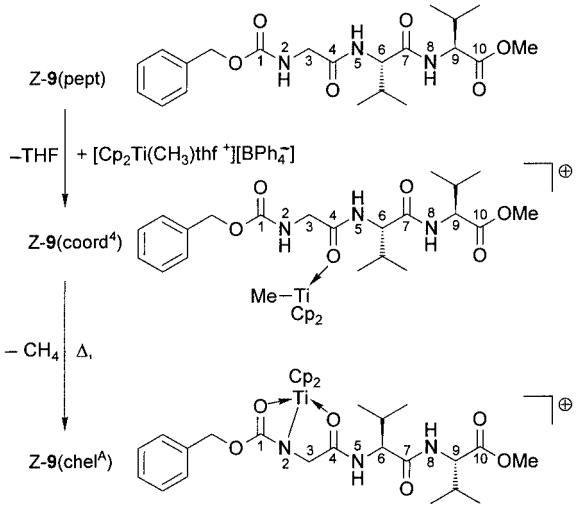
The ^1H and ^{13}C NMR chemical shifts of these 16 tripeptide derivatives were determined using 1D and 2D NMR spectroscopy. These data are presented in Table 4 in the Exp. Sect. It shows that the characteristic NMR features of the peptide backbones are largely independent of the protecting groups. Val and Ala building blocks give rise to characteristic alterations of the ^{13}C NMR chemical shifts at C3, C6, and C9. Glycine, of course, influences these δ values even more and also shows a small systematic decrease in the corresponding δ(C=O) values (see Table 4). The numbering scheme that we have used for characterization of the peptide backbones throughout this paper is depicted in Scheme 4.

Two of the tripeptide derivatives were characterized by X-ray diffraction. They belong to different structural types; Z-**5**(pept) (= Z-Gly-Ala-Ala-OMe) contains two independent molecules in the unit cell, that are only markedly different with regard to the conformational orientation of the phenyl group of the benzyloxycarbonyl protecting group at the *N*-terminus (see Figure 1). Compound Z-**5**(pept) shows no *intramolecular* hydrogen bonds, only *trans*-peptide linkages are found and all torsional angles ω (i.e. $C_\alpha-C_{(o)}-N-C_\alpha$) are close to 180°. However, this peptide derivative exhibits two types of *intermolecular* hydrogen bonds (between the carbonyl oxygen atom O2 and N2*−H of an adjacent molecule *and* between N8−H and C=O7*). This leads to the specific supramolecular peptide framework that is depicted in Figure 1.

Compound Z-**6**(pept) (i.e. Z-Ala-Gly-Ala-OMe) contains the amino acid glycine in the central position. Glycine allows for a fair amount of conformational flexibility inside the peptide chain. Compound Z-**6**(pept) is found to adopt a β-turn-type structure in the solid state (see Figure 2). It requires the involvement of four amino acid residues to complete the typical hydrogen-bonded β-turn ten-membered ring structure, that makes up the almost 180° turn of the peptide backbone structure.[21] In the tripeptide derivative Z-**6**(pept), the carbonyl group of the benzyloxycarbonyl protecting group Z at the *N*-terminus serves as a substitute for the missing fourth amino acid building block. The ten-membered ring in Z-**6**(pept) is then closed between N8−H and the Z-carbonyl oxygen atom C1=O2 (see Figure 2). The β-turn structure of Z-**6**(pept) in the solid state is characterized by the torsional angles φ_{i+1} (i.e. C1−N2−C3−C4) = −57.5(3)°, ψ_{i+1} (N2−C3−C4−N5) = 136.4(2)°, φ_{i+2} (C4−N5−C6−C7) = 71.3(3)°, and ψ_{i+2} (N5−C6−C7−N8) = 8.2(4)°. This is similar to the values for the most commonly observed βII-turn (ideal values: $\varphi_{i+1} = -60°$, $\psi_{i+1} = 120°$, $\varphi_{i+2} = 80°$, $\psi_{i+2} = 0°$).[22]



Scheme 3 . The series of possible primary and secondary products formed by the reaction between the tripeptide derivatives **5**−**12**(pept) with the $[Cp_2TiCH_3(THF)^+]$ salt **13**



Scheme 4

Compound Z-**6**(pept) is characterized by the formation of two additional *intermolecular* hydrogen bonds, namely between N2−H2 and the carbonyl group C7*=O7* (N−H: 0.85 Å; H···O*: 2.04 Å; N−H···O angle: 164°) and between N5−H5 and C*4=O4* (N−H: 0.82 Å; H···O* 2.09 Å; angle 160°), in addition to the *intramolecular* N8−H8···O2 hydrogen bond. This results in the formation of a μ-H-bridged supramolecular structure of the tripeptide derivative Z-**6**(pept), as depicted in Figure 3.

The Cationic Titanocene Complexes

The *N*-protected tripeptide derivatives Z- and Boc-**5**(pept) to -**12**(pept) (see Table 3) were treated with the metallocene cation reagent $[Cp_2TiCH_3(THF)^+][B(C_6F_5)_4^-]$ (**13**).[15] Similarly, as previously observed for the related zirconocene system, the THF ligand is rapidly replaced at low temperature (< 0 °C). In contrast to the zirconium systems,[13,14] the resulting $[\kappa O\text{-}Cp_2Ti(CH)_3(peptide)^+]$ cation complexes are more stable. It usually required several hours at room temperature to allow for the subsequent methane elimination reaction to go to completion. Typically, reaction of the respective peptide derivative with reagent **13** was carried out at ca. −20 °C, and the resulting coordination products [**5**(coord) to **12**(coord)] were characterized by NMR spectroscopy at −5 °C. The samples were then kept overnight at room temperature to cleanly yield the final methane elimination products [**5**(chel) to **12**(chel)]. The latter compounds were all isolated and fully characterized.

The reaction of the protected tripeptides with **13** primarily proceeds by the replacement of the stabilizing THF ligand from the reactive oxophilic methyltitanocene cation, and coordination of the peptide through one of its carbonyl groups. In principle, this could result in the formation of

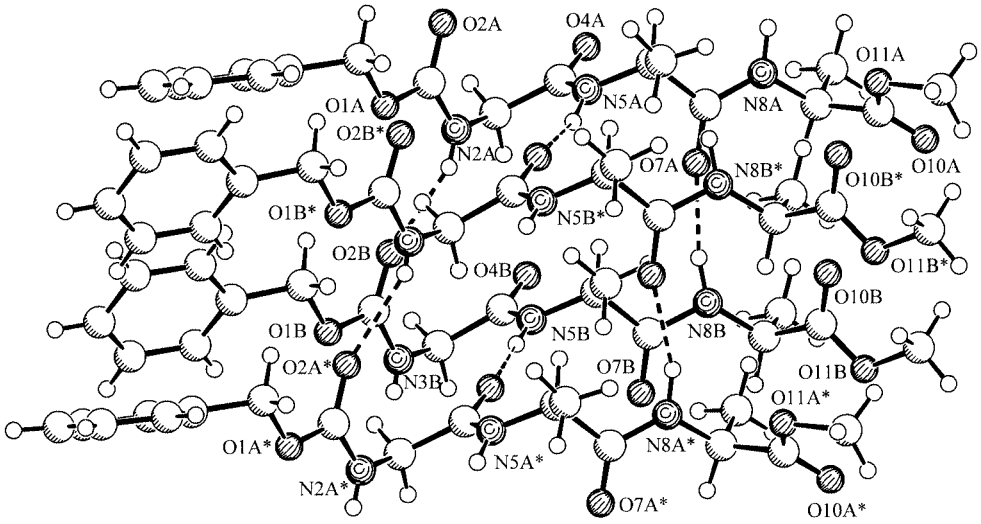


Figure 1. Molecular framework structure of Z-Gly-Ala-Ala-OMe [Z-**5**(pept)] in the solid state; the specific hydrogen bonding pattern between two pairs of Z-**5**(pept) molecules is depicted

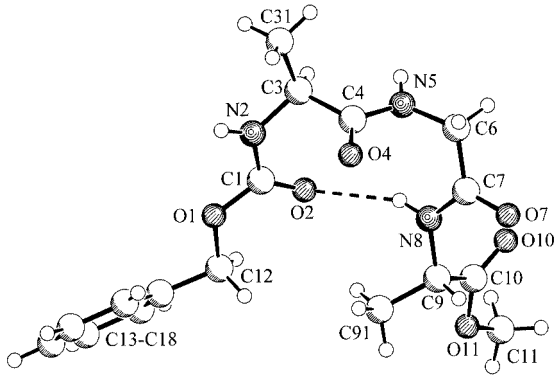


Figure 2. A view of the β-turn-like structure of compound Z-**6**(pept) in the crystal

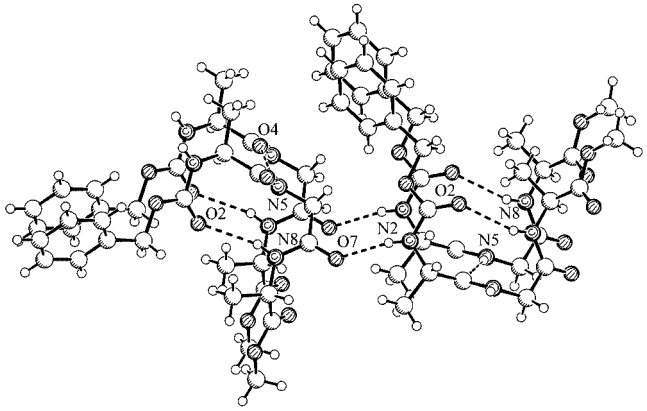


Figure 3. Supramolecular hydrogen-bridged network structure of Z-**6**(pept) in the solid state

four coordination products, which we will name e.g. Z-**5**(coord[1]), -**5**(coord[4]), -**5**(coord[7]), and -**5**(coord[10]), with the superscript denoting the atom number of the coordinating carbonyl group (see Scheme 3). Subsequent thermally induced methane elimination can then result in the formation of three different organometallic products, where the peptide ligand is bonded to the remaining titanocene unit in the typical chelate fashion. We will name these three products accordingly, e.g. Z-**5**(chel^{A}), -**5**(chel^{B}), and -**5**(chel^{C}). Here, the superscript denotes whether the chelate is formed by participation of the carbonyl-containing *N*-terminal protecting group (chel^{A}), the carbonyl group of the *C*-terminal ester (chel^{C}), or just the central peptide bonds (chel^{B}) (see Scheme 3).

The previously described detailed characterization of some of the zirconium complexes[13,14] enabled us to assign the structures of this large (and, as we will see, in some cases, quite complicated) series of (peptide)titanocene cation complexes. A rather simple example may serve as a demonstration. The peptide derivative Z-**9**(pept) (i.e. Z-Gly-Val-Val-OMe) reacts cleanly with **13** to give a single primary carbonyl coordination product, which is identified as Z-**9**(coord[4]).

The ^{13}C and, to a lesser extent, the ^{1}H NMR spectra reveal that in this case the [$Cp_2TiCH_3^+$] moiety is selectively coordinated to the C=O4 carbonyl oxygen. Very characteristically, the ^{13}C NMR resonance of the C4 carbonyl carbon atom is shifted by $\Delta\delta = +8.6$ ppm to a *larger* δ value [(Z-**9**(pept): δ = 169.6 (C4) vs. Z-**9**(coord[4]): δ = 178.2 (C4)]. In contrast, the other three carbonyl carbon chemical shifts are only marginally affected by [$Cp_2TiCH_3^+$] coordination. As expected, metallocene coordination to the C=O4 carbonyl group leads to some spectral changes for the atoms in the direct vicinity of this carbonyl group, most notably the anisotropy effects in the ^{1}H NMR spectra caused by the spatial vicinity of the aromatic Cp-ring systems.

Thus, the glycine 3-H/3-H′ ^{1}H NMR resonances shift to a lower δ value on complex formation, namely from δ = 3.90 ppm [(Z-**9**(pept)] to δ = 1.71 ppm [Z-**9**(coord[4])]. A similar effect is observed for the N2−H proton NMR resonance [δ = 5.92 ppm (pept) vs. δ = 4.23 ppm (coord[4])], and the rather remote C6−H signal [δ = 4.45 ppm (pept) vs. δ = 3.48 ppm (coord[4])], whereas the opposite effect is

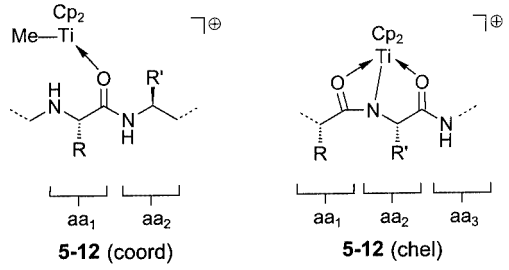
observed for the N5−H resonance [δ = 7.05 ppm (pept), but δ = 7.48 ppm (coord[4])]. Coordination of the titanocene unit results in a diastereotopic splitting of the Cp resonances in **Z-9**(coord[4]) [δ = 6.19 ppm, 6.15 ppm (^{1}H)]. The methyl group at the titanium atom gives rise to a ^{1}H NMR singlet at δ = 1.14 ppm (^{13}C NMR resonance at δ = 52.0 ppm).

Overnight at room temperature, complex **Z-9**(coord[4]) looses 1 equiv. of methane to selectively form a single chelate (peptide)titanocene cation complex. The ^{1}H NMR spectrum shows that the *N2*-bound hydrogen atom is eliminated during this process. Its signal does not appear in the product spectrum and, consequently, we must assume that the [Cp_2Ti^+] unit is κ*N2*-bonded in the product. The overall coordination is likely to be κ^2(*O1*,*O4*),κ*N2*, i.e. the peptide is bound in a chelate fashion to the group-4 metal center, as had been previously demonstrated for the related zirconium systems. In the product **Z-9**(chel[A]), this specific type of bonding leads to very characteristic NMR features. The C4 ^{13}C NMR carbonyl resonance is shifted to larger δ values [δ = 175.3 ppm (chel[A])] relative to the parent peptide derivative [δ = 169.6 ppm (pept)], as is the C3 methylene carbon resonance [δ = 52.2 ppm (chel[A]) vs. δ = 44.8 ppm (pept)]. Remarkably, the κ*O*,κ*N* chelate moiety in this type of product typically leads to the observation of a slightly decreased ^{13}C NMR δ(C1=O) shift [(δ = 151.9 ppm (chel[A]) vs. δ = 156.9 ppm (coord[4]) vs. δ = 157.0 ppm (pept)], which probably results from an electronic compensation effect within the chelating κ*O*,κ*N* peptide anion moiety.[13,14] Of course, the Ti−methyl resonances are no longer observed in the spectra of **Z-9**(chel[A]), and the Cp_2Ti unit gives rise to resonances assigned to a pair of diastereotopic η^5-cyclopentadienide ligands [δ = 6.07 ppm and 6.00 ppm (^{1}H), δ = 118.8 ppm and 118.7 ppm (^{13}C NMR)].

In most other cases, the situation is more complicated than in the titanocene coordination chemistry of **Z-9**(pept). Often, other primary coordination products were obtained, sometimes mixtures of two compounds. In about half of the cases studied, mixtures of two final chelate products were obtained after subsequent methane elimination. In all these cases, the typical ^{1}H and, more importantly, ^{13}C NMR spectra allowed for a clear identification of the individual metal complexes in these mixtures. In the case of the primary [$Cp_2TiCH_3^+$] coordination products, the amino acid to which the metallocene residue was κ*O*-coordinated, could easily be identified, primarily by observing the typical marked downfield shift of the respective ^{13}C NMR carbonyl resonance. Eight examples in our series (for details see Table 2 and the Exp. Sect.) have the alkylmetallocene cation coordinated to the glycine residue on the **5**−**12**(coord) primary product stage. Their respective Gly(*C*=O) ^{13}C NMR chemical shifts are shifted to larger δ values by Δδ ≈ +8.6 and +10.6 (average: $\Delta\delta_{av}$ = +9.3). Similarly, $\Delta\delta_{av}$ = +11.4 for Ala(*C*=O) coordination (6 examples ranging from individual Δδ = +10.2 to +15.8), and $\Delta\delta_{av}$ = +10.4 for Val(*C*=O) coordination (6 individual examples with Δδ between +10.0 and +10.8). The NMR chemical shifts of the adjacent ^{1}H and ^{13}C nuclei are smaller; however, the Δδ ranges are similar to those described above for the selected example of complex **Z-9**(coord). For statistical details see Table 1 and Scheme 5.

Table 1. Individual and averaged ^{1}H and ^{13}C NMR Δδ values observed in the methyl(tripeptide)titanocene cation complexes **5**−**12**(coord) relative to the free peptide derivatives; the structural subunit is depicted in Scheme 5, substituent R followed by the number of individual examples is provided in parentheses

aa_1:	Gly (R = H, 8)	Ala (R = Me, 6)	Val (R = *i*Pr, 6)
N−*H*	−2.06 to −1.35 ∅ = −1.68	−1.18 to +1.35 ∅ = −0.60	−2.29 to −0.32 ∅ = −1.07
α-C*H*R	−2.19 to −1.67 ∅ = −1.87	−0.79 to −0.20 ∅ = −0.55	−0.69 to +0.16 ∅ = −0.28
α-*C*HR	−0.1 to +0.6 ∅ = +0.1	−0.4 to +1.5 ∅ = +1.0	−2.8 to +4.2 ∅ = +2.6
C=O	+8.6 to +10.6 ∅ = +9.3	+10.2 to +15.8 ∅ = +11.4	+10.0 to +10.8 ∅ = +10.4
aa_2:	Gly (R′ = H, 4)	Ala (R′ = Me, 8)	Val (R′ = *i*Pr, 8)
N−*H*	+0.76 to +1.83 ∅ = +1.18	+0.27 to +1.46 ∅ = +1.01	−1.03 to +1.81 ∅ = +0.58
α-C*H*R	−0.31 to −0.18 ∅ = −0.27	−0.96 to −0.49 ∅ = −0.70	−0.98 to +0.26 ∅ = −0.62
α-*C*HR	+0.9 to +1.4 ∅ = +1.2	−0.4 to +1.9 ∅ = +1.4	−0.4 to +2.8 ∅ = +1.4



Scheme 5

Similarly, characteristic Δδ values are observed for the pairs of adjacent amino acid moieties that coordinate to the [Cp_2Ti^+] unit after CH_4 elimination in the products **5**−**12**(chel). In all cases strong Δδ effects are observed for the ^{13}C NMR resonances of the carbonyl group, *and* its adjacent α-carbon atom of the amino acid unit AS_2 (see Scheme 5) inside the five-membered chelate ring of the overall metallabicyclic structural subunits. The average ^{13}C NMR Δδ(*C*=O) values are about +5.7 ppm (see Table 2). The shielding effect is even larger for the α-*C*HR ^{13}C NMR resonance, with $\Delta\delta_{av}$ values between +9.0 and +10.3 ppm (see Table 2). The Δδ values of the *C*=O group in the anellated four-membered κ*O*,κ*N*-chelate is again much smaller because of the "carboxamide compensation effect". This is similar to that observed for the analogous zirconium complexes.[13,14]

With these characteristic NMR spectroscopic data it is possible to analyze the resulting product mixtures in a rather straightforward manner. The results are listed in Table 2. It can be seen that coordination of the intact

Table 2. Range of Δδ values for **5**−**12**(chel) relative to the free tripeptide derivatives **5**−**12**(pept); the structural subunit is depicted in Scheme 5, R and number of examples in parentheses

aa_1:	Gly (R = H, 2)	Ala (R = Me, 6)	Val (R = *i*Pr, 6)
α-C*H*R	−0.45, −0.35 ∅ = −0.40	−0.41 to −0.03 ∅ = −0.17	−0.46 to +0.20 ∅ = −0.22
α-*C*HR	−1.8, −1.4 ∅ = −1.6	−2.8 to +2.0 ∅ = −1.7	−2.4 to +0.2 ∅ = −1.6
C=O	+2.1 and +2.4 ∅ = +2.3	−1.3 to +1.4 ∅ = +0.7	+1.6 to +5.9 ∅ = +3.4
aa_2:	Gly (R′ = H, 7)	Ala (R′ = Me, 10)	Val (R′ = *i*Pr, 8)
α-C*H*R	−0.15 to +0.39 ∅ = +0.11	−0.16 to +0.58 ∅ = +0.33	+0.12 to +1.07 ∅ = +0.65
α-*C*HR	+7.4 to +10.1 ∅ = +9.0	+7.9 to +10.5 ∅ = +9.6	+8.7 to +12.3 ∅ = +10.3
C=O	+5.3 to +6.1 ∅ = +5.8	+5.2 to +6.4 ∅ = +5.6	+3.5 to +6.5 ∅ = +5.8

[$Cp_2TiCH_3^+$] cation to the amido carbonyl oxygen atom of the central amino acid building block of the tripeptide framework is favored in the majority of the cases. A single such product is formed in the cases of Z- and Boc-**6**, -**7**, -**8**, -**10**, and -**11**(coord^7). Deviations from this behavior are observed in the cases where the small glycine building block is located at the *N*-terminus of the tripeptide. Pure Z- and Boc-**9**(coord^4) adducts are formed in the PG-Gly-Val-Val-OMe series, and mixtures of the respective Z- and Boc-**5**(coord^4) and -**5**(coord^7) adducts are found in the PG-Gly-Ala-Ala-OMe cases (see Table 3).

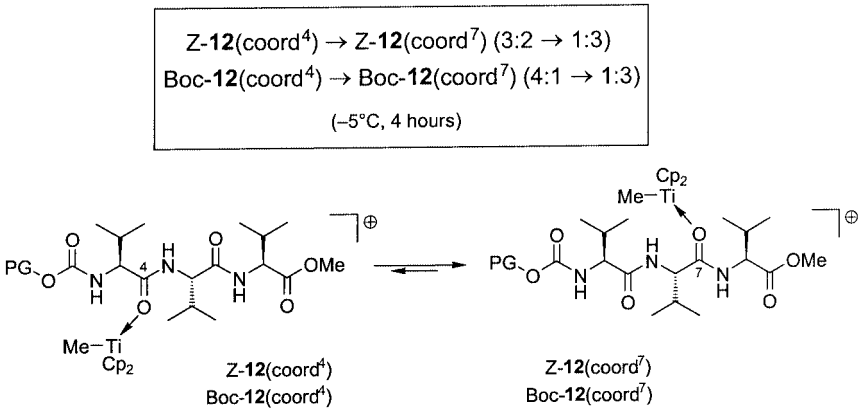
The situation is similar for the final products obtained after subsequent thermally induced methane elimination, although in some cases it is slightly more complicated. Once again, it can be seen from Table 3 that coordination to the central section of the tripeptide framework is by far favored, i.e. the dominating products are Z- and Boc-**5**−**11**(chel^B), where the chelate structure is formed by the involvement of two adjacent amino acid moieties, without any participation of the carbonyl groups of the *N*-terminal protecting group nor the *C*-terminal ester. However, in many cases, mixtures of (chel^B) and (chel^A) (mostly minor) are found. Only in the extreme cases of Z- and Boc-Gly-Val-Val-OMe did we find the selective formation of the otherwise less favored **9**(chel^A) products that involve glycine and the RO−CO protective functionality in chelate bonding (see Table 3). The products (coord^1), (coord^{10}), or (chel^C) (see Scheme 3) were never observed in this series of experiments.

Methane elimination from the cationic primary coordination products [(coord)] is much slower in the case of the titanocene complexes than for the previously described zirconocene relatives. In one case, this has allowed for the observation of a rearrangement process at the stage of the formation of the κ*O*-[$Cp_2TiCH_3^+$] coordination products. The peptide Z-Val-Val-Val-OMe [Z-**12**(pept)] forms a 3:2 mixture of the two [$Cp_2TiCH_3^+$] coordination products Z-**12**(coord^4) and Z-**12**(coord^7). After 4 h at −5 °C, this changed to a ratio of Z-**12**(coord^4)/Z-**12**(coord^7) of 1:3. In the case of the Boc-protected system, Boc-**12**, the situation is even more pronounced. A Boc-**12**(coord^4)/Boc-**12**(coord^7) mixture of 4:1 is initially formed at −5 °C, that changed to a 1:3 ratio in favor of the generally thermodynamically favored internal coordination product after 4 h at −5 °C (see Scheme 6).

Table 3. A compilation of the products formed by the reaction of the tripeptide derivatives **5**−**12** with [$Cp_2TiCH_3^+$][BPh_4^-] (**13**)

Peptide (pept):	Coordination product (coord^4)/(coord^7)	Chelate product (chel^A)/(chel^B)
Alanine series:		
Z-Gly-Ala-Ala-OMe Z-**5**	2:1	−:1[a]
Boc-Gly-Ala-Ala-OMe Boc-**5**	3:1	1:2
Z-Ala-Gly-Ala-OMe Z-**6**	−:1	1:2
Boc-Ala-Gly-Ala-OMe Boc-**6**	−:1	1:2
Z-Ala-Ala-Gly-OMe Z-**7**	−:1	−:1
Boc-Ala-Ala-Gly-OMe Boc-**7**	−:1	1:2
Z-Ala-Ala-Ala-OMe Z-**8**	−:1	−:1
Boc-Ala-Ala-Ala-OMe Boc-**8**	−:1	3:2
Valine series:		
Z-Gly-Val-Val-OMe Z-**9**	1:−	1:−
Boc-Gly-Val-Val-OMe Boc-**9**	1:−	1:−
Z-Val-Gly-Val-OMe Z-**10**	−:1	−:1
Boc-Val-Gly-Val-OMe Boc-**10**	−:1	−:1
Z-Val-Val-Gly-OMe Z-**11**	−:1	2:3
Boc-Val-Val-Gly-OMe Boc-**11**	−:1	2:3
Z-Val-Val-Val-OMe Z-**12**[b]	3:2	1:1
Z-Val-Val-Val-OMe Z-**12**[c]	1:3	
Boc-Val-Val-Val-OMe Boc-**12**[b]	4:1	2:3
Boc-Val-Val-Val-OMe Boc-**12**[c]	1:3	

[a] −:1 denotes that only this specific single product is observed. [b] Initial ratio. [c] Ratio after rearrangement (4 h at −5 °C).



Scheme 6

Conclusions

We had previously shown that the "Jordan cation" $[Cp_2Zr(CH_3)(THF)^+]$[12] reacts with oligopeptide derivatives by displacement of THF and addition of the methylzirconocene cation to a peptide C=O moiety. Subsequently, rapid methane elimination was observed to yield the $[(peptide)Cp_2Zr^+]$ chelate complexes.[13,14] We have now shown that the reagent $[Cp_2Ti(CH_3)(THF)^+]$ reacts with Z- or Boc-protected tripeptide esters in a similar way; first, coordination to a peptide carbonyl oxygen atom is observed [(coord) product formation]; subsequently a thermally induced CH_4 elimination is observed to yield the respective (chel) products.

However, there are notable differences between the zirconocene- and titanocene-based reactions that make the latter more interesting and probably more important. The methylzirconocene cation reagent is much more reactive. Consequently, a dominating (coord^4) product formation was observed, followed by a rather rapid CH_4 elimination to predominately yield the chelate product that involved bonding of the C=O group of the respective alkoxycarbonyl protective group at the *N*-terminus of the peptide. In this respect, the Cp_2Zr^+-derived chemistry is not to be regarded as simple and typical peptide framework chemistry, but rather as a combination of general peptide and specific protective group chemistry.

This is significantly different in the Cp_2Ti^+ systems described here. We have predominately observed the formation of a purely peptide-derived internal chelate product (chel^B) that involves only a pair of adjacent amino acid moieties of the peptide framework. In a few cases, the (chel^A) product that involves bonding of the protective group is observed as a minor component of the product mixture. Only in cases where there is a significant difference in the steric bulk of the backbone units (see Table 3) was the (chel^A) product dominant. A similarly significant difference between the Cp_2Zr^+- and Cp_2Ti^+-derived systems is observed in the regioselectivity of the primary attack. In almost all cases, the internal coordination product (coord^7) was obtained at low temperature. Only in very few specific cases was (coord^4) product formation observed for titanium, in contrast to zirconium where this dominated. The Cp_2Ti^+ adducts are, in some cases, "just resistant enough" to allow a secondary rearrangement to be observed experimentally. The products Z-**12**(coord^4) and Boc-**12**(coord^4) seem to be formed under kinetic control, but then slowly rearrange to form their favored isomers Z-**12**(coord^7) and Boc-**12**(coord^7), respectively. For the first time it seems that we have observed the (intra- or intermolecular) migration of a group-4 metallocene cation derivative along an oligopeptide chain, with the metallocene actively searching for the best resting place available at the peptide backbone, before undergoing further reactions. We will see if this might serve as a first step towards the development of achieving the selective information transfer between a typical biomolecule chain and a catalytically active transition metal center.

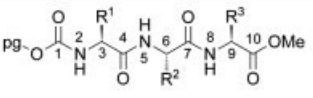
Experimental Section

General: All reactions involving organometallic compounds were carried out under argon using a modified Schlenk technique or a glovebox. Melting points were determined with a differential scanning calorimeter TA-Instruments 2010 and the infrared spectra were recorded in KBr with a Nicolet 5 DXC FT IR spectrometer. A Perkin−Elmer polarimeter 241 was used to determine the optical rotations (25 °C; λ = 589 nm). Elemental analyses were performed with a Foss-Heraeus CHNO-Rapid apparatus. NMR spectra were recorded in CD_2Cl_2 at −5 °C with a 600 MHz Varian UNITYplus spectrometer. Chemical shifts (δ) are given in ppm, coupling constants (*J*) in Hz. Commercially available reagents were used as purchased. The reagents HCl·H-Gly-OMe,[23] HCl·H-Ala-OMe,[24] HCl·H-Val-OMe,[25] Boc-Gly-Ala-OH,[26] Boc-Gly-Val-OH,[27] Boc-Ala-Gly-OH,[28] Boc-Ala-Ala-OH,[29] Boc-Val-Gly-OH,[30] Boc-Val-Val-OH,[31] Z-Ala-Ala-OH,[32] and $[Cp_2TiCH_3(THF)^+][BPh_4^-]$ (**13**)[15] were prepared as described in the literature.

General Procedure of the Preparation of the Protected Tripeptides:[20c,33] Two separated ice-cooled solutions were prepared. In the first case triethylamine (0.69 mL, 506 mg, 5.00 mmol) was added to an ice-cooled solution of 20 mL of chloroform and the hydrochloride of the amino acid methyl ester (5.00 mmol). The second was prepared by adding IIDQ (1.52 g, 5.00 mmol) to the Boc- or Z-protected dipeptide (5.00 mmol) in 20 mL of chloroform while stirring. After stirring for 10 min at 0 °C, both solutions were com-

bined. The mixture was allowed to warm up to room temperature overnight. The reaction mixture was filtered and then extracted with 30 mL of aqueous 10% citric acid, 5% $NaHCO_3$ solution and water. The organic solution was dried with $MgSO_4$. The solvent was then removed in vacuo. Recrystallization of the crude product from ethyl acetate/cyclohexane (1:10) or purification by column chromatography gave the pure products. The characteristic NMR features of the 16 tripeptide derivatives prepared and used in this study are listed in Table 4.

Table 4. Selected ^1H and ^{13}C NMR spectroscopic data for the tripeptide derivatives **5**(pept) to **12**(pept)



pg = $(C_6H_5)CH_2$–, $(CH_3)_3C$–

	1	2	3	4	5	6	7	8	9	10
Z-**5**(pept)		6.06	3.87		7.28	4.62		7.37	4.45	
ZGAAOMe	156.8		44.3	169.2		48.8	172.2		48.2	173.3
Boc-**5**(pept)		5.76	3.79		7.35	4.61		7.48	4.45	
BGAAOMe	156.2		44.0	169.7		48.7	172.3		48.2	173.3
Z-**6**(pept)		6.02	4.17		7.41	3.92		7.36	4.43	
ZAGAOMe	156.3		51.0	173.3		42.7	168.8		48.1	173.5
Boc-**6**(pept)		5.65	4.10		7.47	3.93		7.39	4.45	
BAGAOMe	155.9		50.7	173.8		42.8	169.1		48.3	173.5
Z-**7**(pept)		6.91	4.05		7.62	4.35		7.83	3.83	
ZAAGOMe	156.2		50.8	172.6		48.4	172.9		40.7	170.3
Boc-**7**(pept)		6.24	3.98		7.48	4.35		7.77	3.84	
BAAGOMe	155.8		50.5	172.9		48.4	172.9		40.8	170.3
Z-**8**(pept)		6.68	4.11		7.51	4.37		7.61	4.36	
ZAAAOMe	156.2		50.8	172.6		48.4	172.2		47.9	173.3
Boc-**8**(pept)		6.06	4.07		7.48	4.40		7.67	4.37	
BAAAOMe	155.6		50.3	172.9		48.5	172.3		48.0	173.3
Z-**9**(pept)		5.92	3.90		7.05	4.45		7.02	4.45	
ZGVVOMe	157.0		44.8	169.6		58.7	171.5		57.7	172.5
Boc-**9**(pept)		6.14	3.86		7.84	4.45		7.72	4.54	
BGVVOMe	156.2		43.9	170.0		57.3	172.6		58.5	172.2
Z-**10**(pept)		5.92	4.07		7.32	4.00		7.24	4.45	
ZVGVOMe	156.6		60.5	172.3		43.1	168.9		57.4	172.5
Boc-**10**(pept)		5.32	3.98		7.08	3.96		7.00	4.44	
BVGVOMe	156.0		60.0	172.4		43.1	168.9		57.4	172.5
Z-**11**(pept)		6.83	3.92		7.53	4.21		8.07	3.81	
ZVVGOMe	156.4		60.6	171.5		57.8	171.7		40.7	170.3
Boc-**11**(pept)		5.62	3.98		7.23	4.36		7.62	3.98	
BVVGOMe	156.2		60.4	172.1		58.2	171.8		41.0	170.2
Z-**12**(pept)		6.73	3.95		7.69	4.27		7.72	4.26	
ZVVVOMe	156.3		60.4	171.6		57.9	171.6		57.3	172.2
Boc-**12**(pept)		5.79	4.00		7.49	4.49		7.28	4.42	
BVVVOMe	156.0		60.1	172.3		57.1	171.7		58.7	172.4

[a] First line ^1H, second line $^{13}C\{^1H\}$ NMR spectroscopic data; the different amino acid fragments are illustrated by different colors: white (glycine or C1), light grey (alanine), dark grey (valine)

Representative Experimental Procedure of the Reaction of $[Cp_2TiCH_3(THF)^+][BPh_4^-]$ (13) with the Tripeptides (Monitored by NMR Spectroscopy): Equimolar amounts of **13** and the respective tripeptide derivative (ca. 20 mg, both in 0.5 mL CD_2Cl_2) were combined at −20 °C. After stirring for 10 min, the reaction mixture was decanted to a precooled NMR tube. The reaction was monitored by NMR spectroscopy at −5 °C and the resulting products identified. The reaction mixture was then stored for 12 h at room temperature to complete the formation of the chelate products. Only NMR spectroscopic data of the cations are listed below since the $[BPh_4^-]$ resonances are equivalent in all examples: ^1H NMR (tetraphenylborate): δ = 7.35 (m, 8 H, *ortho*-H), 7.06 (m, 8 H, *meta*-H), 6.92 (m, 4 H, *para*-H) ppm. ^{13}C NMR: δ = 164.6 (q, $^1J_{CB}$ = 49 Hz, C-*ipso*), 136.3 (C-*ortho*), 126.0 (C-*meta*), 122.1 (C-*para*) ppm. ^1H NMR (THF): δ = 3.70 (m, 4 H, α-H), 1.83 (m, 4 H, β-H). ^{13}C NMR: δ = 68.2 ppm (C-α), 26.0 (C-β).

General Procedure of the Preparation of the (Tripeptide)titanium Complexes: Reagent **13** (0.371 mmol), dissolved in 5 mL of CH_2Cl_2, was added to a solution of the respective tripeptide (0.371 mmol) in 5 mL of CH_2Cl_2 at −20 °C. The reaction mixture was allowed to warm to room temperature overnight. After removal of the solvent in vacuo, an orange-red residue was obtained. The solid was washed with 20 mL of pentane (2 ×), and dried under vacuum to yield the respective chelate (peptide)Ti cation complex. Only selected NMR spectra of the (coord)- and (chel)-type metal complexes are listed below. A complete compilation of data from the 1D and 2D NMR spectroscopic analysis is provided as Supporting Information.

Z-5(pept) (Z-Gly-Ala-Ala-OMe): Reaction of Z-Gly-Ala-OH (1.00 g, 3.57 mmol) with HCl·H-Ala-OMe (498 mg, 3.57 mmol) , triethylamine (0.50 mL, 3.57 mmol), IIDQ (1.08 g, 3.57 mmol) yielded 1.02 g (78%) of Z-**5**(pept). Single crystals were obtained by recrystallization from ethyl acetate. M.p. (DSC) 131 °C. $[\alpha]_D = -21$ (c = 1.0, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3321 (br. s, NH), 3063 (w), 2998 (w), 2953 (w), 1734 (vs, COO), 1692 (vs, CON), 1661 (vs, CON), 1530 (br. s), 1456 (m), 1344 (m), 1271 (br. s), 1150 (m), 1057 (m), 733 (m), 661 (w) cm^{-1}. $C_{17}H_{23}N_3O_6$ (365.4): calcd. C 55.88, H 6.34, N 11.50; found C 55.76, H 6.41, N 11.32.

X-ray Crystal Structure Analysis: Formula $C_{17}H_{23}N_3O_6$, M = 365.38, colorless crystal 0.45 × 0.20 × 0.05 mm, a = 6.135(1), b = 8.222(3), c = 18.418(3) Å, α = 84.94(2), β = 87.14(2), γ = 83.38(2)°, V = 918.5(4) $Å^3$, $\rho_{calcd.}$ = 1.321 g cm^{-3}, μ = 8.46 cm^{-1}, empirical absorption correction with ψ-scan data ($0.702 \leq T \leq 0.959$), Z = 2, triclinic, space group $P\bar{1}$ (no. 1), λ = 1.54178 Å, T = 223 K, ω/2θ scans, 4018 reflections collected ($\pm h$, $+k$, $\pm l$), [(sinθ)/λ] = 0.62 $Å^{-1}$, 4018 independent and 1688 observed reflections [$I \geq 2\,\sigma(I)$], 493 refined parameters, R = 0.057, wR^2 = 0.123, Flack parameter −0.2(4), max. residual electron density 0.24 (−0.21) e $Å^{-3}$, hydrogen atoms at the nitrogen atoms from difference Fourier calculations, others calculated and all refined as riding atoms.

Reaction of Z-5(pept) with 13

Z-5(coord^4)/Z-5(coord^7) = 2:1. Z-5(coord^4): ^1H NMR: δ = 7.55 (br., 1 H, 5-H), 7.37 [m, 5 H, 1-$OCH_2(C_6H_5)$], 6.46 (br. d, ^3J = 7.0 Hz, 1 H, 8-H), 6.20 and 6.17 (Cp-H and Cp′-H), 5.06 [AB, ^2J = 12.5 Hz, 2 H, 1-$OCH_2(C_6H_5)$], 4.44 (m, 1 H, 9-H), 4.34 (AB*X*, 1 H, 2-H), 3.73 (s, 3 H, 10-OCH_3), 3.66 (m, 1 H, 6-H), 1.98 (*AB*X, 2 H, 3-H and 3-H′), 1.42 (d, ^3J = 7.3 Hz, 3 H, 9-CH_3), 1.30 (d, ^3J = 7.2 Hz, 3 H, 6-CH_3), 1.12 (s, 3 H, Ti−CH_3) ppm. ^{13}C NMR: δ = 178.0 (C-4), 172.9 (C-10), 168.4 (C-7), 157.2 (C-1), 138.7 to 122.0 {1-$OCH_2(C_6H_5)$ and $[BPh_4]^-$}, 116.7 and 116.6 (C-Cp and C-Cp′), 67.7 [1-$OCH_2(C_6H_5)$], 52.9 (10-OCH_3), 52.3 (Ti−CH_3), 49.8 (C-9), 48.4 (C-6), 44.8 (C-3), 18.2 (6-CH_3), 17.6 (9-CH_3) ppm. **Z-5(coord^7):** ^1H NMR: δ = 8.63 (br. d, ^3J = 8.4 Hz, 1 H, 5-H), 7.37 [m, 5 H, 1-$OCH_2(C_6H_5)$], 6.08 (br., 1 H, 8-H, not visible), 6.27 and 6.26 (Cp-H and Cp′-H), 5.26 (AB*X*, 1 H, 2-H), 5.05 [AB, ^2J = 12.6 Hz, 2 H, 1-$OCH_2(C_6H_5)$], 3.83 (m, 1 H, 6-H), 3.78 (s, 3 H, 10-OCH_3), 3.66 (m, 1 H, 9-H), 3.38 (*AB*X, ^2J = 16.7 Hz, 2 H, 3-H and 3-H′), 1.44 (d, ^3J = 7.2 Hz, 3 H, 6-CH_3), 1.13 (s, 3 H, Ti−CH_3), 0.96 (d, ^3J = 7.3 Hz, 3 H, 9-CH_3) ppm. ^{13}C NMR: δ = 188.0 (C-7), 182.3 (C-10), 169.7 (C-4), 158.2 (C-1), 138.7−122.0 {1-$OCH_2(C_6H_5)$ and $[BPh_4]^-$}, 116.9 and 116.8 (C-Cp and C-Cp′), 67.8 [1-$OCH_2(C_6H_5)$], 53.3 (10-OCH_3), 51.7 (Ti−CH_3), 49.8 (C-9), 48.4 (C-6), 45.2 (C-3), 16.7 (9-CH_3), 15.9 (6-CH_3) ppm.

Product Z-5(chel^B): Reaction of Z-**5**(pept) (113 mg, $3.09 \cdot 10^{-4}$ mol) with **13** (181 mg, $3.09 \cdot 10^{-4}$ mol) yielded 248 mg (93%) of orange-red Z-**5**(chel^B). M.p. (DSC): 46 °C (dec.). $[\alpha]_D = -29$ (c = 1.0,

CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3360 (br., NH), 3059 (w), 3034 (w), 1740 (m, COO), 1700 (s, CON), 1653 (s, CON), 1617 (vs, CON), 1521 (s), 1454 (s), 1261 (m), 1237 (m), 1153 (w), 1062 (w), 1030 (w), 824 (m), 735 (s), 706 (vs), 613 (w) cm^{-1}. ^1H NMR: δ = 7.37 [m, 5 H, 1-$OCH_2(C_6H_5)$], 7.68 (br., 1 H, 8-H), 6.09 and 6.07 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.30 (AB*X*, 1 H, 2-H), 5.12 [AB, ^2J = 12.6 Hz, 2 H, 1-$OCH_2(C_6H_5)$], 4.46 (m, 1 H, 6-H), 4.26 (m, 1 H, 9-H), 3.78 (s, 3 H, 10-OCH_3), 3.42 (*AB*X, ^3J = 17.0 Hz, 2 H, 3-H and 3-H′), 1.42 (d, ^3J = 7.1 Hz, 3 H, 6-CH_3), 1.40 (d, ^3J = 7.3 Hz, 3 H, 9-CH_3) ppm. ^{13}C NMR: δ = 178.1 (C-7), 171.3 and 171.1 (C-4 and C-10), 156.8 (C-1), 138.8 to 122.2 {1-$OCH_2(C_6H_5)$ and $[BPh_4]^-$}, 118.5 and 118.2 (C-Cp and C-Cp′), 67.3 [1-$OCH_2(C_6H_5)$], 58.7 (C-6), 53.3 (10-OCH_3), 50.1 (C-9), 42.5 (C-3), 20.2 (6-CH_3), 17.0 (9-CH_3) ppm. $C_{51}H_{52}BN_3O_6Ti$ (861.7): calcd. C 71.09, H 6.08, N 4.88; found C 69.14, H 6.52, N 4.55.

Boc-5(pept) (Boc-Gly-Ala-Ala-OMe): Reaction of Boc-Gly-Ala-OH (1.68 g, 6.82 mmol) with HCl·H-Ala-OMe (952 mg, 6.82 mmol), triethylamine (0.95 mL, 6.82 mmol), and IIDQ (2.07 g, 6.82 mmol) yielded 1.51 g (67%) Boc-**5**(pept). R_f = 0.42 (ethyl acetate). M.p. (DSC): 117 °C. $[\alpha]_D$ = −25 (*c* = 1.0, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3286 (br. s, NH), 3085 (w), 2981 (m), 1748 (s, COO), 1716 (s, CON), 1650 (vs, CON), 1532 (br. s), 1453 (m), 1367 (m), 1285 (m), 1223 (s), 1169 (s), 1053 (m), 945 (m), 689 (w) cm^{-1}. $C_{14}H_{25}N_3O_6$ (331.4): calcd. C 50.75, H 7.60, N 12.68; found C 50.72, H 7.67, N 12.80.

Reaction of Boc-5(pept) with 13

Boc-5(coord^4)/Boc-5(coord^7) = 3:1. Boc-5(coord^4): ^1H NMR: δ = 7.75 (br. d, ^3J = 7.1 Hz, 1 H, 5-H), 6.53 (br. d, ^3J = 7.3 Hz, 1 H, 8-H), 6.20 and 6.19 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 4.45 (m, 1 H, 9-H), 4.41 (AB*X*, 1 H, 2-H), 3.72 (s, 3 H, 10-OCH_3), 3.68 (m, 1 H, 6-H), 2.12 (*AB*X, ^2J = 18.4 Hz, 2 H, 3-H and 3-H′), 1.43 [s, 9 H, 1-$OC(CH_3)_3$], 1.41 (d, ^3J = 7.1 Hz, 3 H, 9-CH_3), 1.31 (d, ^3J = 7.2 Hz, 3 H, 6-CH_3), 1.13 (s, 3 H, Ti−CH_3) ppm. ^{13}C NMR: δ = 178.3 (C-4), 172.8 (C-10), 168.6 (C-7), 156.4 (C-1), 116.7 and 116.6 (C-Cp and C-Cp′), 81.7 [1-$OC(CH_3)_3$], 52.8 (10-OCH_3), 52.0 (Ti−CH_3), 50.0 (C-6), 48.8 (C-9), 44.6 (C-3), 28.0 [1-$OC(CH_3)_3$], 18.3 (6-CH_3), 17.6 (9-CH_3). **Boc-5(coord^7):** ^1H NMR: δ = 8.94 (br. d, ^3J = 8.4 Hz, 1 H, 8-H), 6.74 (br. d, ^3J = 7.9 Hz, 1 H, 5-H), 2 × 6.28 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.09 (AB*X*, 1 H, 2-H), 4.41 (m, 1 H, 6-H), 3.85 (m, 1 H, 9-H), 3.79 (s, 3 H, 10-OCH_3), 3.41 (*AB*X, ^2J = 16.9 Hz, 2 H, 3-H and 3-H′), 1.43 [s, 9 H, 1-$OC(CH_3)_3$], 1.46 (d, ^3J = 7.3 Hz, 3 H, 9-CH_3), 1.34 (d, ^3J = 7.2 Hz, 3 H, 6-CH_3), 1.14 (s, 3 H, Ti−CH_3) ppm. ^{13}C NMR: δ = 182.6 (C-7), 172.3 (C-10), 169.8 (C-4), 156.7 (C-1), 116.9 and 116.8 (C-Cp and C-Cp′), 80.6 [1-$OC(CH_3)_3$], 52.7 (10-OCH_3), 51.6 (Ti−CH_3), 49.8 and 48.9 (C-6 and C-9), 45.0 (C-3), 28.1 [1-$OC(CH_3)_3$], 18.1 and 16.7 (6-CH_3 and 9-CH_3) ppm.

Products Boc-5(chel^A)/Boc-5(chel^B) = 1:2: Reaction of Boc-**5**(pept) (123 mg, $3.71 \cdot 10^{-4}$ mol) with **13** (217 mg, $3.09 \cdot 10^{-4}$ mol) yielded 289 mg (94%) of the orange isomeric mixture Boc-**5**(chel^A)/Boc-**5**(chel^B) = 1:2. M.p. (DSC): 77 °C (dec.). $[\alpha]_D$ = −69 (*c* = 0.65, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3369 (br., NH), 3055 (m), 2984 (m), 1746 (s, COO), 1695 (s, CON), 1614 (vs, CON), 1506 (s), 1450 (s), 1367 (w), 1250 (m), 1155 (s), 1030 (w), 826 (s), 735 (s), 706 (vs), 613 (m) cm^{-1}. $C_{48}H_{54}BN_3O_6Ti$ (827.7): calcd. C 69.66, H 6.58, N 5.08; found C 69.82, H 7.15, N 4.81. **Boc-5(chel^A):** ^1H NMR: δ = 7.76 (br., 1 H, 5-H), 7.11 (br., 1 H, 8-H), 6.11 and 6.07 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 4.46 (m, 1 H, 9-H), 4.31 (m, 1 H, 6-H), 4.03 (AB, ^2J = 18.4 Hz, 2 H, 3-H and 3-H′), 3.80 (s, 3 H, 10-OCH_3), 1.54 [s, 9 H, 1-$OC(CH_3)_3$], 1.43 (d, ^3J = 7.2 Hz, 3 H, 6-CH_3), 1.36 (d, ^3J = 7.1 Hz, 3 H, 9-CH_3) ppm. ^{13}C NMR: δ = 175.8 (C-4), 171.5 (C-10), 169.8 (C-7), 153.3 (C-1), 118.4 and 118.3 (C-Cp and C-Cp′), 84.4 [1-$OC(CH_3)_3$], 52.9 (C-3), 52.7 (10-OCH_3), 50.5 (C-9), 48.6 (C-6), 28.9 [1-$OC(CH_3)_3$], 18.5, 18.2, 18.0 and 17.1 (6-CH_3 and 9-CH_3). **Boc-5(chel^B):** ^1H NMR: δ = 6.84 (br., 1 H, 8-H), 5.21 (AB*X*, 1 H, 2-H), 2 × 6.13 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 4.71 (q, ^3J = 7.0 Hz, 1 H, 6-H), 4.46 (m, 1 H, 9-H), 3.72 (s, 3 H, 10-OCH_3), 3.44 (*AB*X, ^2J = 18.3 Hz, 2 H, 3-H and 3-H′), 1.50 (d, ^3J = 7.0 Hz, 3 H, 6-CH_3), 1.45 [s, 9 H, 1-$OC(CH_3)_3$], 1.36 (d, ^3J = 7.1 Hz, 3 H, 9-CH_3) ppm. ^{13}C NMR: δ = 178.7 (C-7), 172.1 (C-4), 170.1 (C-10), 156.6 (C-1), 118.5 and 118.1 (C-Cp and C-Cp′), 80.7 [1-$OC(CH_3)_3$], 59.2 (C-6), 52.8 (10-OCH_3), 51.2 (C-9), 42.6 (C-3), 28.4 [1-$OC(CH_3)_3$], 18.5, 18.2, 18.0 and 17.1 (6-CH_3 and 9-CH_3) ppm.

Z-6(pept) (Z-Ala-Gly-Ala-OMe): Reaction of Z-Ala-Gly-OH (1.50 g, 5.35 mmol) with HCl·H-Ala-OMe (747 mg, 5.35 mmol), triethylamine (0.75 mL, 5.35 mmol), and IIDQ (1.62 g, 5.35 mmol) yielded 1.62 g (83%) of Z-**6**(pept). M.p. (DSC): 131 °C. $[\alpha]_D$ = −5 (*c* = 1.0, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3355 (s, NH), 3307 (s, NH), 3352 (s, NH), 3049 (w), 1742 (s, COO), 1702 (s, CON), 1658 (vs, CON), 1549 (s), 1456 (m), 1313 (m), 1266 (s), 1236 (m), 1155 (m), 1039 (w), 659 (w) cm^{-1}. $C_{17}H_{23}N_3O_6$ (365.4): calcd. C 55.88, H 6.34, N 11.50; found C 56.03, H 6.45, N 11.67.

X-ray Crystal Structure Analysis: Formula $C_{17}H_{23}N_3O_6$, *M* = 365.38, colorless crystal 0.50 × 0.10 × 0.05 mm, *a* = 4.674(2), *b* = 16.520(2), *c* = 24.166(3) Å, *V* = 1866.0(9) $Å^3$, $\rho_{calcd.}$ = 1.301 g cm^{-3}, μ = 8.33 cm^{-1}, empirical absorption correction with ψ scan data (0.681 ≤ *T* ≤ 0.960), *Z* = 4, orthorhombic, space group $P2_12_12_1$ (no. 19), λ = 1.54178 Å, *T* = 223 K, ω/2θ scans, 2246 reflections collected (−*h*, +*k*, +*l*), [(sinθ)/λ] = 0.62 $Å^{-1}$, 2246 independent and 1764 observed reflections [$I \geq 2\,\sigma(I)$], 248 refined parameters, *R* = 0.038, wR^2 = 0.099, Flack parameter −0.4(4), max. residual electron density 0.19 (−0.21) e $Å^{-3}$, hydrogen atoms at the nitrogen atoms from difference Fourier calculations, others calculated and all refined as riding atoms.

Data sets were collected with an Enraf Nonius CAD4 diffractometer. Programs used: data collection EXPRESS (Nonius B.V., 1994), data reduction MolEN (K. Fair, Enraf−Nonius B.V., **1990**), structure solution SHELXS-97 (G. M. Sheldrick, *Acta Crystallogr.* **1990**, *A46*, 467−473), structure refinement SHELXL-97 (G. M. Sheldrick, Universität Göttingen, **1997**), graphics SCHAKAL (E. Keller, Universität Freiburg, **1997**). Crystallographic data (excluding structure factors) for the structures reported in this paper have been deposited with the Cambridge Crystallographic Data Centre as supplementary publication CCDC-184568 and -184569. Copies of the data can be obtained free of charge on application to CCDC, 12 Union Road, CambridgeCB2 1EZ, UK [Fax: (internat.) + 44-1223/336-033, E-mail: deposit@ccdc.cam.ac.uk].

Reaction of Z-6(pept) with 13. Z-6(coord^7): ^1H NMR: δ = 8.35 (br. d, ^3J = 8.4 Hz, 1 H, 8-H), 7.38 [m, 5 H, 1-$OCH_2(C_6H_5)$], 6.19 and 6.18 (Cp-H and Cp′-H), 5.40 (AB*X*, 1 H, 5-H), 5.27 (br. d, ^3J = 3.8 Hz, 1 H, 2-H), 5.10 [AB, ^2J = 12.5 Hz, 2 H, 1-$OCH_2(C_6H_5)$], 3.81 (s, 3 H, 10-OCH_3), 3.77 (m, 1 H, 9-H), 3.58 (m, 1 H, 3-H), 2.20 (*AB*X, ^2J = 17.9 Hz, 2 H, 6-H and 6-H′), 1.46 (d, ^3J = 7.3 Hz, 3 H, 9-CH_3), 1.24 (d, ^3J = 7.3 Hz, 3 H, 3-CH_3), 1.06 (s, 3 H, Ti−CH_3) ppm. ^{13}C NMR: δ = 178.1 (C-7), 172.5 (C-4), 170.2 (C-10), 157.1 (C-1), 138.9 to 122.3 {1-$OCH_2(C_6H_5)$ and $[BPh_4]^-$}, 116.7 and 116.5 (C-Cp and C-Cp′), 67.7 [1-$OCH_2(C_6H_5)$], 53.2 (10-OCH_3), 52.0 (Ti−CH_3), 51.3 (C-3), 49.8 (C-9), 42.8 (C-6), 16.4 (9-CH_3), 16.3 (6-CH_3) ppm.

Products Z-6(chel^A)/Z-6(chel^B) = 1:2: Reaction of Z-**6**(pept) (98 mg, $2.44 \cdot 10^{-4}$ mol) with **13** (142 mg, $2.44 \cdot 10^{-4}$ mol) yielded

204 mg (97%) of the orange isomeric mixture Z-**6**(chel^{A})/Z-**6**(chel^{B}) = 1:2. M.p. (DSC): 69 °C (dec.). $[\alpha]_D = -32$ (c = 1.0, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3348 (br., NH), 3056 (w), 3032 (w), 2983 (w), 1747 (s, COO), 1696 (s, CON), 1617 (s, CON), 1517 (s), 1453 (s), 1260 (m), 1026 (m), 820 (m), 734 (s), 705 (vs), 612 (m) cm^{-1}. $C_{51}H_{52}BN_3O_6Ti$ (861.7): calcd. C 71.09, H 6.08, N 4.88; found C 71.56, H 6.56, N 4.54. **Z-6(chel^{A}):** ^{1}H NMR: δ = 7.37 [m, 5 H, 1-OCH$_2$(C_6H_5)], 7.22 (br. d, ^3J = 7.5 Hz, 1 H, 8-H), 6.78 (ABX, 1 H, 5-H), 6.05 and 6.00 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.09 [AB, ^2J = 12.1 Hz, 2 H, 1-OCH$_2$(C_6H_5)], 4.43 (m, 1 H, 9-H), 4.38 (m, 1 H, 3-H), 3.69 (s, 3 H, 10-OCH$_3$), 3.77 (ABX, 2 H, 6-H and 6-H′), 1.43 (d, ^3J = 7.2 Hz, 3 H, 9-CH$_3$), 1.32 (d, ^3J = 7.1 Hz, 3 H, 3-CH$_3$) ppm. ^{13}C NMR: δ = 178.9 (C-4), 173.8 (C-10), 169.5 (C-7), 156.9 (C-1), 138.8−122.2 {1-OCH$_2$(C_6H_5) and [BPh_4]$^-$}, 118.6 and 118.4 (C-Cp and C-Cp′), 67.4 [1-OCH$_2$(C_6H_5)], 58.9 (C-3), 52.7 (10-OCH$_3$), 52.1 (C-9), 43.4 (C-6), 17.4 and 17.2 (3-CH$_3$ and 9-CH$_3$). **Z-6(chel^{B}):** ^{1}H NMR: δ = 7.37 [m, 5 H, 1-OCH$_2$(C_6H_5)], 6.92 (br., 1 H, 8-H), 6.06 and 6.05 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.47 (br., 1 H, 2-H), 5.14 [AB, ^2J = 12.2 Hz, 2 H, 1-OCH_2(C_6H_5)], 4.14 (m, 1 H, 3-H), 3.84 (AB, ^2J = 19.0 Hz, 2 H, 6-H and 6-H′), 3.81 (m, 1 H, 9-H), 3.77 (s, 3 H, 10-OCH_3), 1.37 (d, ^3J = 7.3 Hz, 3 H, 3-CH_3), 1.26 (d, ^3J = 7.3 Hz, 3 H, 9-CH_3) ppm. ^{13}C NMR: δ = 174.8 (C-7), 173.8 (C-4), 171.2 (C-10), 156.0 (C-1), 138.8−122.2 {1-OCH$_2$(C_6H_5) and [BPh_4]$^-$}, 118.6 and 118.5 (C-Cp and C-Cp′), 67.2 [1-OCH$_2$(C_6H_5)], 53.1 (10-OCH$_3$), 52.8 (C-6), 50.1 (C-9), 49.6 (C-3), 16.9 (9-CH$_3$), 15.3 (3-CH$_3$) ppm.

Boc-6(pept) (Boc-Ala-Gly-Ala-OMe): Reaction of Boc-Ala-Gly-OH (1.76 g, 7.13 mmol) with HCl·H-Ala-OMe (996 mg, 7.13 mmol), triethylamine (0.99 mL, 7.13 mmol), and IIDQ (2.16 g, 7.13 mmol) yielded 1.46 g (62%) of Boc-**6**(pept). R_f = 0.41 (ethyl acetate). M.p. (DSC): 219 °C. $[\alpha]_D = -7$ (c = 1.0, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3304 (br. s, NH), 2985 (w), 2939 (w), 1749 (s, COO), 1695 (vs, CON), 1652 (vs, CON), 1558 (s), 1456 (m), 1369 (w), 1325 (w), 1299 (m), 1280 (m), 1253 (s), 1167 (m), 1063 (w), 996 (w), 669 (w) cm^{-1}. $C_{14}H_{25}N_3O_6$ (331.4): calcd. C 50.75, H 7.60, N 12.68; found C 50.45, H 7.89, N 12.62.

Reaction of Boc-6(pept) with 13. Boc-6(coord^{7}): ^{1}H NMR: δ = 8.50 (br. d, ^3J = 7.4 Hz, 1 H, 8-H), 6.18 and 6.16 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.75 (ABX, 1 H, 5-H), 5.00 (br. d, ^3J = 3.6 Hz, 1 H, 2-H), 3.79 (s, 3 H, 10-OCH_3), 3.78 (m, 1 H, 9-H), 3.56 (m, 1 H, 3-H), 2.10 (ABX, 2 H, 6-H and 6-H′), 1.48 [s, 9 H, 1-OC(CH_3)$_3$], 1.46 (d, ^3J = 7.2 Hz, 3 H, 9-CH_3), 1.25 (d, ^3J = 7.2 Hz, 3 H, 3-CH_3), 1.04 (s, 3 H, Ti−CH_3) ppm. ^{13}C NMR: δ = 178.4 (C-7), 172.5 (C-4), 170.1 (C-10), 157.0 (C-1), 116.7 and 116.5 (C-Cp and C-Cp′), 81.5 [1-OC(CH$_3$)$_3$], 53.1 (10-OCH$_3$), 51.4 (C-3), 51.3 (Ti−CH$_3$), 49.8 (C-9), 42.7 (C-6), 28.2 [1-OC(CH$_3$)$_3$], 2 × 16.4 (3-CH$_3$ and 9-CH$_3$).

Products Boc-6(chel^{A})/Boc-6(chel^{B}) = 1:2: Reaction of Boc-**6**(pept) (164 mg, 4.95·10^{-4} mol) with **13** (289 mg, 4.95·10^{-4} mol) gave 393 mg (96%) of the orange isomeric mixture Boc-**6**(chel^{A})/Boc-**6**(chel^{B}) = 1:2. M.p. (DSC): 81 °C (dec.). $[\alpha]_D = -23$ (c = 0.55, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3369 (br., NH), 3055 (w), 2984 (w), 1746 (m, COO), 1695 (s, CON), 1616 (vs, CON), 1580 (m), 1483 (s), 1450 (s), 1369 (w), 1261 (s), 1211 (m), 1157 (vs), 1101 (s), 1065 (s), 1016 (s), 824 (s), 735 (m), 706 (vs), 613 (w) cm^{-1}. $C_{48}H_{54}BN_3O_6Ti$ (827.7): calcd. C 69.66, H 6.58, N 5.08; found C 69.86, H 7.21, N 4.75. **Boc-6(chel^{A}):** ^{1}H NMR: δ = 7.23 (br., 1 H, 8-H), 5.98 (ABX, 1 H, 5-H), 6.09 and 6.08 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 4.44 (m, 1 H, 9-H), 4.33 (q, ^3J = 6.9 Hz, 1 H, 3-H), 3.68 (s, 3 H, 10-OCH_3), 3.10 (ABX, ^2J = 16.8 Hz, 2 H, 6-H and 6-H′), 1.52 [s, 9 H, 1-OC(CH_3)$_3$], 1.44 (d, ^3J = 7.1 Hz, 3 H, 9-CH_3), 1.38 (d, ^3J = 7.2 Hz, 3 H, 3-CH_3) ppm. ^{13}C NMR: δ = 179.0 (C-4), 173.3 (C-10), 165.9 (C-7), 156.4 (C-1), 118.2 and 118.1 (C-Cp and C-Cp′), 83.9 [1-OC(CH$_3$)$_3$], 59.0 (C-3), 52.9 (10-OCH$_3$), 48.5 (C-9), 43.4 (C-6), 28.7 [1-OC(CH$_3$)$_3$], 18.3 (3-CH$_3$), 16.4 (9-CH$_3$) ppm. **Boc-6(chel^{B}):** ^{1}H NMR: δ = 6.63 (br., 1 H, 8-H), 6.10 and 6.07 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.19 (br., 1 H, 2-H), 4.12 (m, 1 H, 9-H), 3.78 (AB, ^2J = 19.1 Hz, 2 H, 6-H and 6-H′), 3.75 (s, 3 H, 10-OCH_3), 3.69 (m, 1 H, 3-H), 1.47 [s, 9 H, 1-OC(CH_3)$_3$], 1.35 (d, ^3J = 7.2 Hz, 3 H, 9-CH_3), 1.22 (d, ^3J = 7.0 Hz, 3 H, 3-CH_3) ppm. ^{13}C NMR: δ = 174.9 (C-7), 172.5 (C-4), 171.2 (C-10), 155.5 (C-1), 2 × 118.3 (C-Cp and C-Cp′), 81.5 [1-OC(CH$_3$)$_3$], 53.1 (10-OCH$_3$), 52.7 (C-3), 52.2 (C-6), 49.8 (C-9), 28.2 [1-OC(CH$_3$)$_3$], 16.8 (9-CH$_3$), 15.2 (3-CH$_3$) ppm.

Z-7(pept) (Z-Ala-Ala-Gly-OMe):[34] Reaction of Z-Ala-Ala-OH (1.00 g, 3.40 mmol) with HCl·H-Gly-OMe (427 mg, 3.40 mmol), triethylamine (0.48 mL, 3.40 mmol), and IIDQ (1.04 g, 3.40 mmol) yielded 1.06 g (85%) of Z-**7**(pept). M.p. (DSC): 181 °C. $[\alpha]_D = -26$ (c = 0.5, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3285 (br. s, NH), 1749 (s, COO), 1686 (s, CON), 1638 (vs, CON), 1539 (s), 1455 (w), 1267 (m), 1243 (m), 1225 (s), 1051 (w), 698 (w) cm^{-1}. $C_{17}H_{23}N_3O_6$ (365.4): calcd. C 55.88, H 6.34, N 11.50; found C 55.89, H 6.45, N 11.46.

Reaction of Z-7(pept) with 13. Z-7(coord^{7}): ^{1}H NMR: δ = 8.59 (ABX, 1 H, 8-H), 7.37 [m, 5 H, 1-OCH$_2$(C_6H_5)], 6.44 (br., 1 H, 5-H), 2 × 6.25 (Cp-H and Cp′-H), 5.43 (br., 1 H, 2-H), 5.12 [AB, 2 H, 1-OCH_2(C_6H_5)], 3.91 (m, 1 H, 3-H), 3.80 (s, 3 H, 10-OCH_3), 3.76 (m, 1 H, 6-H), 3.52 (ABX, ^2J = 17.6 Hz, 2 H, 9-H and 9-H′), 1.30 (d, ^3J = 7.3 Hz, 3 H, 3-CH_3), 1.14 (s, 3 H, Ti−CH_3), 1.08 (d, ^3J = 7.3 Hz, 3 H, 6-CH_3) ppm. ^{13}C NMR: δ = 183.4 (C-7), 173.0 (C-4), 167.3 (C-10), 158.1 (C-1), 138.8 to 122.1 {1-OCH$_2$(C_6H_5) and [BPh_4]$^-$}, 116.9 and 116.8 (C-Cp and C-Cp′), 68.1 [1-OCH$_2$(C_6H_5)], 53.3 (10-OCH$_3$), 52.4 (C-3), 51.4 (Ti−CH$_3$), 49.9 (C6), 41.9 (C-9), 16.7 (3-CH$_3$), 16.1 (6-CH$_3$).

Product Z-7(chel^{B}): Reaction of Z-**7**(pept) (127 mg, 3.48·10^{-4} mol) with **13** (203 mg, 3.48·10^{-4} mol) yielded 227 mg (89%) of Z-**7**(chel^{B}). M.p. (DSC): 77 °C (dec.). $[\alpha]_D = -26$ (c = 1.0, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3292 (br., NH), 3056 (w), 2964 (w), 1748 (m, COO), 1686 (s, CON), 1640 (vs, CON), 1621 (m, CON), 1539 (m), 1437 (w), 1262 (vs), 1226 (s), 1153 (m), 1099 (vs), 1018 (vs), 802 (vs), 734 (m), 705 (s) cm^{-1}. ^{1}H NMR: δ = 7.36 [m, 5 H, 1-OCH$_2$(C_6H_5)], 6.06 and 5.98 (Cp-H and Cp′-H), 6.00 (ABX, 1 H, 8-H), 5.36 (br. d, ^3J = 5.8 Hz, 1 H, 2-H), 5.12 [AB, ^2J = 12.3 Hz, 2 H, 1-OCH_2(C_6H_5)], 4.70 (q, ^3J = 7.1 Hz, 1 H, 6-H), 3.94 (m, 1 H, 3-H), 3.73 (s, 3 H, 10-OCH_3), 3.31 (ABX, 2 H, 9-H and 9-H′), 1.32 (d, ^3J = 7.1 Hz, 3 H, 6-CH_3), 1.29 (d, ^3J = 7.1 Hz, 3 H, 3-CH_3) ppm. ^{13}C NMR: δ = 178.4 (C-7), 173.9 (C-4), 168.4 (C-10), 156.0 (C-1), 138.8−122.2 {1-OCH$_2$(C_6H_5) and [BPh_4]$^-$}, 118.4 and 118.0 (C-Cp and C-Cp′), 67.3 [1-OCH_2(C_6H_5)], 58.7 (C-6), 52.8 (10-OCH$_3$), 48.2 (C-3), 42.5 (C-9), 20.8 (6-CH$_3$), 16.1 (3-CH$_3$) ppm. $C_{51}H_{52}BN_3O_6Ti$ (861.7): calcd. C 71.09, H 6.08, N 4.88; found C 71.26, H 5.86, N 4.66.

Boc-7(pept) (Boc-Ala-Ala-Gly-OMe): Reaction of Boc-Ala-Ala-OH (1.31 g, 5.03 mmol) with HCl·H-Gly-OMe (6.27 mg, 5.03 mmol), triethylamine (0.70 mL, 5.03 mmol), and IIDQ (1.53 g, 5.03 mmol) yielded 1.18 g (71%) of Boc-**7**(pept). R_f = 0.39 (ethyl acetate/cyclohexane, 4:1). M.p. (DSC): 173 °C. $[\alpha]_D = -48$ (c = 0.5, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3312 (s, NH), 3278 (s, NH), 2980 (w), 1749 (s, COO), 1675 (s, CON), 1639 (vs, CON), 1520 (s), 1456 (m), 1261 (s), 1172 (m), 1054 (w), 668 (w) cm^{-1}. $C_{14}H_{25}N_3O_6$ (331.4): calcd. C 50.75, H 7.60, N 12.68; found C 50.22, H 7.61, N 12.61.

Reaction of Boc-7(pept) with 13: Boc-7(coord^{7}): ^{1}H NMR: δ = 9.02 (ABX, 1 H, 8-H), 6.53 (br. d, ^3J = 4.9 Hz, 1 H, 5-H), 6.26 and

6.25 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.19 (br., 1 H, 2-H), 3.86 (m, 1 H, 3-H), 3.82 (m, 1 H, 6-H), 3.78 (s, 3 H, 10-OCH_3), 3.57 (*AB*X, ^2J = 17.3 Hz, 2 H, 9-H and 9-H′), 1.44 [s, 9 H, 1-OC(CH_3)$_3$], 1.29 (d, ^3J = 7.2 Hz, 3 H, 3-CH_3), 1.15 (s, 3 H, Ti−CH_3), 1.13 (d, ^3J = 7.3 Hz, 3 H, 6-CH_3) ppm. ^{13}C NMR: δ = 183.6 (C-7), 173.3 (C-4), 167.2 (C-10), 157.9 (C-1), 116.9 and 116.8 (C-Cp and C-Cp′), 82.4 [1-O*C*(CH$_3$)$_3$], 53.3 (10-O*C*H$_3$), 52.3 (C-3), 51.4 (Ti−*C*H$_3$), 49.7 (C-6), 41.9 (C-9), 28.1 [1-OC(*C*H$_3$)$_3$], 16.7 (3-*C*H$_3$), 16.3 (6-*C*H$_3$) ppm.

Products Boc-7(chel^A)/Boc-7(chel^B) = 1:2: Reaction of Boc-**7**(pept) (151 mg, 4.56·10^{-4} mol) with **13** (266 mg, 4.56·10^{-4} mol) yielded 347 mg (92%) of the isomeric mixture Boc-**7**(chel^A)/Boc-**7**(chel^B) = 1:2. M.p. (DSC): 68 °C (dec.). [α]$_D$ = −33 (*c* = 1.0, CH_2Cl_2). IR (KBr): ṽ = 3315 (s, NH), 3281 (m, NH), 2980 (w), 1765 (w, COO), 1747 (m, COO), 1676 (s, CON), 1641 (vs, CON), 1518 (s), 1456 (w), 1261 (s), 1168 (m), 1099 (vs), 1022 (s), 802 (s), 742 (w), 706 (m) cm^{-1}. $C_{48}H_{54}BN_3O_6Ti$ (827.7): calcd. C 69.66, H 6.58, N 5.08; found C 68.91, H 7.02, N 4.82. **Boc-7(chel^A):** ^{1}H NMR: δ = 7.55 (br., 1 H, 5-H), 6.13 and 6.12 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.76 (ABX, 1 H, 8-H), 4.55 (q, ^3J = 6.9 Hz, 1 H, 3-H), 4.09 (m, 1 H, 6-H), 3.80 (ABX, ^2J = 18.2 Hz, 2 H, 9-H and 9-H′), 3.72 (s, 3 H, 10-OCH$_3$), 1.54 (d, ^3J = 7.1 Hz, 3 H, 3-CH$_3$), 1.53 [s, 9 H, 1-OC(CH$_3$)$_3$], 1.32 (d, ^3J = 7.0 Hz, 3 H, 6-CH$_3$) ppm. ^{13}C NMR: δ = 178.2 (C-4), 170.5 (C-7), 169.9 (C-10), 152.6 (C-1), 118.4 and 118.1 (C-Cp and C-Cp′), 84.2 [1-OC(CH$_3$)$_3$], 59.3 (C-3), 52.6 (10-OCH$_3$), 50.5 (C-6), 41.3 (C-9), 28.7 [1-OC(CH$_3$)$_3$], 18.8 (6-CH$_3$), 18.4 (3-CH$_3$) ppm. **Boc-7(chel^B):** ^{1}H NMR: δ = 6.10 and 6.09 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 6.01 (AB*X*, 1 H, 8-H), 5.04 (br. d, ^3J = 5.8 Hz, 1 H, 2-H), 4.79 (q, ^3J = 7.1 Hz, 1 H, 6-H), 3.89 (m, 1 H, 3-H), 3.74 (s, 3 H, 10-OCH_3), 3.32 (*AB*X, 2 H, 9-H and 9-H′), 1.46 [s, 9 H, 1-OC(CH_3)$_3$], 1.35 (d, ^3J = 7.0 Hz, 3 H, 6-CH_3), 1.28 (d, ^3J = 7.1 Hz, 3 H, 3-CH_3) ppm. ^{13}C NMR: δ = 178.5 (C-7), 174.6 (C-4), 168.4 (C-10), 155.5 (C-1), 118.4 and 118.0 (C-Cp and C-Cp′), 80.6 [1-O*C*(CH$_3$)$_3$], 58.7 (C-6), 52.8 (10-O*C*H$_3$), 47.9 (C-3), 42.5 (C-9), 28.1 [1-OC(*C*H$_3$)$_3$], 20.9 (6-*C*H$_3$), 15.9 (3-*C*H$_3$) ppm.

Z-8(pept) (Z-Ala-Ala-Ala-OMe):[35] Reaction of Z-Ala-Ala-OH (1.00 g, 3.40 mmol) with HCl·H-Ala-OMe (474 mg, 3.40 mmol), triethylamine (0.47 mL, 3.40 mmol), and IIDQ (1.03 g, 3.40 mmol) yielded 0.92 g (71%) of Z-**8**(pept). M.p. (DSC): 174 °C. [α]$_D$ = −30 (*c* = 1.0, CH_2Cl_2). IR (KBr): ṽ = 3303 (s, NH), 3275 (s, NH), 3068 (w), 2984 (w), 1739 (s, COO), 1689 (s, CON), 1640 (vs, CON), 1542 (s), 1455 (w), 1331 (w), 1257 (s), 1231 (m), 1158 (w), 1052 (m), 697 (m) cm^{-1}. $C_{18}H_{25}N_3O_6$ (379.4): calcd. C 56.98, H 6.64, N 11.08; found C 57.00, H 6.80, N 10.92.

Reaction of Z-8(pept) with 13. Z-8(coord^7): ^{1}H NMR: δ = 8.78 (br. d, ^3J = 8.4 Hz, 1 H, 8-H), 7.38 [m, 5 H, 1-OCH$_2$(C$_6$*H*$_5$)], 6.36 (br. d, ^3J = 5.0 Hz, 1 H, 5-H), 2 × 6.27 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.44 (br. d, 1 H, 2-H), 5.11 [AB, ^2J = 12.0 Hz, 2 H, 1-OC*H*$_2$(C$_6$H$_5$)], 3.95 (m, 1 H, 3-H), 3.86 (m, 1 H, 9-H), 3.81 (s, 3 H, 10-OCH_3), 3.80 (m, 1 H, 6-H), 1.45 (d, ^3J = 7.2 Hz, 3 H, 9-CH_3), 1.34 (d, ^3J = 7.1 Hz, 3 H, 3-CH_3), 1.15 (s, 3 H, Ti−CH_3), 1.01 (d, ^3J = 7.3 Hz, 3 H, 6-CH_3) ppm. ^{13}C NMR: δ = 182.4 (C-7), 172.5 (C-4), 170.0 (C-10), 158.0 (C-1), 136.0−122.0 {1-OCH$_2$(*C*$_6$H$_5$) and [BPh$_4$]$^-$}, 116.9 and 116.8 (C-Cp and C-Cp′), 68.0 [1-O*C*H$_2$(C$_6$H$_5$)], 53.3 (10-O*C*H$_3$), 52.5 (C-3), 51.7 (Ti−*C*H$_3$), 2 × 49.8 (C-6 and C-9), 17.0 (3-*C*H$_3$), 16.7 (9-*C*H$_3$), 16.0 (6-*C*H$_3$) ppm.

Product Z-8(chel^B): Reaction of Z-**8**(pept) (135 mg, 3.56·10^{-4} mol) with **13** (208 mg, 3.56·10^{-4} mol) yielded 293 mg (94%) of Z-**8**(chel^B). M.p. (DSC): 79 °C (dec.). [α]$_D$ = −59 (*c* = 1.0, CH_2Cl_2). IR (KBr): ṽ = 3357 (br., NH), 3055 (w), 2985 (w), 1743 (m, COO), 1660 (s, CON), 1616 (vs, CON), 1521 (m), 1481 (m), 1454 (s), 1237 (m), 1065 (m), 1018 (m), 825 (s), 734 (s), 705 (vs), 613 (m) cm^{-1}. ^{1}H NMR: δ = 7.45 (br. d, ^3J = 8.8 Hz, 1 H, 8-H), 7.37 [m, 5 H, 1-OCH$_2$(C$_6$*H*$_5$)], 6.09 and 6.01 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.39 (br. d, ^3J = 6.3 Hz, 1 H, 2-H), 5.11 [AB, ^2J = 12.3 Hz, 2 H, 1-OC*H*$_2$(C$_6$H$_5$)], 4.91 (q, ^3J = 7.0 Hz, 1 H, 6-H), 4.30 (m, 1 H, 9-H), 3.94 (m, 1 H, 3-H), 3.79 (s, 3 H, 10-OCH_3), 1.51 (d, ^3J = 7.0 Hz, 3 H, 6-CH_3), 1.42 (d, ^3J = 7.3 Hz, 3 H, 9-CH_3), 1.31 (d, ^3J = 7.0 Hz, 3 H, 3-CH_3) ppm. ^{13}C NMR: δ = 178.0 (C-7), 173.9 (C-4), 171.4 (C-10), 156.1 (C-1), 138.8−122.1 {1-OCH$_2$(*C*$_6$H$_5$) and [BPh$_4$]$^-$}, 118.4 and 118.2 (C-Cp and C-Cp′), 67.3 [1-O*C*H$_2$(C$_6$H$_5$)], 58.9 (C-6), 53.3 (10-O*C*H$_3$), 50.2 (C-9), 48.3 (C-3), 21.0 (6-*C*H$_3$), 17.1 (9-*C*H$_3$), 15.9 (3-*C*H$_3$) ppm. $C_{52}H_{54}BN_3O_6Ti$ (875.7): calcd. C 71.32, H 6.22, N 4.80; found C 71.28, H 6.33, N 4.73.

Boc-8(pept) (Boc-Ala-Ala-Ala-OMe):[36] Reaction of Boc-Ala-Ala-OH (1.05 g, 4.03 mmol) with HCl·H-Ala-OMe (563 mg, 4.03 mmol), triethylamine (0.56 mL, 4.03 mmol), and IIDQ (1.22 g, 4.03 mmol) yielded 1.11 g (80%) of Boc-**8**(pept). M.p. (DSC): 185 °C. [α]$_D$ = −48 (*c* = 1.0, CH_2Cl_2). IR (KBr): ṽ = 3298 (s, NH), 3272 (s, NH), 2981 (m), 1744 (s, COO), 1709 (s, CON), 1692 (s, CON), 1675 (s, CON), 1638 (vs, CON), 1550 (s), 1524 (s), 1456 (m), 1365 (w), 1252 (m), 1218 (m), 1170 (m), 1052 (w), 703 (br. w) cm^{-1}. $C_{15}H_{27}N_3O_6$ (345.4): calcd. C 52.16, H 7.88, N 12.17; found C 52.84, H 7.87, N 12.07.

Reaction of Boc-8(pept) with 13: Boc-8(coord^7): ^{1}H NMR: δ = 9.07 (br. d, ^3J = 8.2 Hz, 1 H, 8-H), 6.40 (br. d, ^3J = 5.0 Hz, 1 H, 5-H), 2 × 6.29 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.12 (br. d, ^3J = 2.2 Hz, 1 H, 2-H), 3.90 (m, 1 H, 3-H), 3.88 (m, 1 H, 9-H), 3.80 (s, 3 H, 10-OCH_3), 3.80 (m, 1 H, 6-H), 1.48 (d, ^3J = 7.3 Hz, 3 H, 9-CH_3), 1.45 [s, 9 H, 1-OC(CH_3)$_3$], 1.32 (d, ^3J = 7.3 Hz, 3 H, 3-CH_3), 1.14 (s, 3 H, Ti−CH_3), 1.32 (d, ^3J = 7.4 Hz, 3 H, 6-CH_3) ppm. ^{13}C NMR: δ = 182.7 (C-7), 172.6 (C-4), 169.9 (C-10), 157.6 (C-1), 116.9 and 116.8 (C-Cp and C-Cp′), 82.3 [1-O*C*(CH$_3$)$_3$], 53.3 (10-O*C*H$_3$), 52.2 (C-3), 51.7 (Ti−*C*H$_3$), 49.9 (C-9), 49.8 (C-6), 27.9 [1-OC(*C*H$_3$)$_3$], 16.9 (3-*C*H$_3$), 16.8 (9-*C*H$_3$), 16.4 (6-*C*H$_3$) ppm.

Products Boc-8(Chel^A)/Boc-8(Chel^B) = 3:2: Reaction of Boc-**8**(pept) (117 mg, 3.39·10^{-4} mol) with **13** (198 mg, 3.39·10^{-4} mol) yielded 251 mg (88%) of the isomeric mixture Boc-**8**(Chel^A)/Boc-**8**(Chel^B) = 3:2. M.p. (DSC): 68 °C (dec.). [α]$_D$ = −20 (*c* = 1.0, CH_2Cl_2). IR (KBr): ṽ = 3301 (br., NH), 3054 (w), 2981 (m), 1743 (m, COO), 1695 (s, CON), 1653 (vs, CON), 1617 (vs, CON), 1522 (s), 1480 (s), 1451 (s), 1262 (m), 1157 (m), 1066 (m), 1018 (s), 820 (s), 733 (m), 704 (vs) cm^{-1}. $C_{49}H_{56}BN_3O_6Ti$ (841.7): calcd. C 69.92, H 6.71, N 4.99; found C 71.07, H 7.45, N 4.55. **Boc-8(Chel^A):** ^{1}H NMR: δ = 7.39 (br., 1 H, 5-H), 6.10 and 6.07 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.98 (br. d, ^3J = 7.2 Hz, 1 H, 8-H), 4.52 (q, ^3J = 6.9 Hz, 1 H, 3-H), 4.43 (m, 1 H, 9-H), 4.09 (m, 1 H, 6-H), 3.72 (s, 3 H, 10-OCH_3), 1.54 (d, ^3J = 7.3 Hz, 3 H, 3-CH_3), 1.52 [s, 9 H, 1-OC(CH_3)$_3$], 1.35 (d, ^3J = 8.0 Hz, 3 H, 6-CH_3), 1.35 (d, ^3J = 7.7 Hz, 3 H, 9-CH_3) ppm. ^{13}C NMR: δ = 178.1 (C-4), 172.8 (C-10), 169.7 (C-7), 152.7 (C-1), 118.4 and 118.1 (C-Cp and C-Cp′), 84.2 [1-O*C*(CH$_3$)$_3$], 59.3 (C-3), 52.9 (10-O*C*H$_3$), 50.4 (C-6), 48.7 (C-9), 28.7 [1-OC(*C*H$_3$)$_3$], 18.5 (3-*C*H$_3$), 19.2 and 17.9 (6-*C*H$_3$ and 9-*C*H$_3$) ppm. **Boc-8(Chel^B):** ^{1}H NMR: δ = 7.16 (br. d, ^3J = 8.8 Hz, 1 H, 8-H), 6.11 and 6.10 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 4.98 (br. d, ^3J = 5.7 Hz, 1 H, 2-H), 4.98 (q, ^3J = 7.3 Hz, 1 H, 6-H), 4.30 (m, 1 H, 9-H), 3.88 (m, 1 H, 3-H), 3.79 (s, 3 H, 10-OCH_3), 1.52 (d, ^3J = 7.4 Hz, 3 H, 6-CH_3), 1.43 [s, 9 H, 1-OC(CH_3)$_3$], 1.42 (d, ^3J = 7.7 Hz, 3 H, 9-CH_3), 1.28 (d, ^3J = 8.0 Hz, 3 H, 3-CH_3) ppm. ^{13}C NMR: δ = 178.0 (C-7), 174.3 (C-4), 171.4 (C-10), 155.4

(C-1), 118.4 and 118.2 (C-Cp and C-Cp′), 80.6 [1-O*C*(CH_3)$_3$], 58.9 (C-6), 53.4 (10-O*C*H_3), 50.2 (C-9), 47.8 (C-3), 28.1 [1-OC(*C*H_3)$_3$], 21.1 (6-*C*H_3), 17.2 (9-*C*H_3), 15.8 (3-*C*H_3) ppm.

Z-9(pept) (Z-Gly-Val-Val-OMe):[37] Reaction of Z-Gly-Val-OH (1.00 g, 3.24 mmol) with HCl·H-Val-OMe (544 mg, 3.24 mmol), triethylamine (0.45 mL, 3.24 mmol), and IIDQ (984 mg, 3.24 mmol) yielded 0.91 g (67%) of Z-**9**(pept). M.p. (DSC): 143 °C. $[\alpha]_D = -12$ (c = 1.0, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3296 (br. s, NH), 2963 (m), 1748 (s, COO), 1692 (s, CON), 1643 (vs, CON), 1539 (s), 1393 (w), 1294 (m), 1248 (s), 1040 (w), 699 (m) cm^{-1}. $C_{21}H_{31}N_3O_6$ (421.5): calcd. C 59.84, H 7.41, N 9.97; found C 59.35, H 7.41, N 9.77.

Reaction of Z-9(pept) with 13. Z-9(coord^4): ^{1}H NMR: δ = 7.48 (br. d, ^3J = 9.2 Hz, 1 H, 5-H), 7.38 [m, 5 H, 1-OCH$_2$(C$_6$*H*$_5$)], 6.19 and 6.15 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 6.13 (br. d, ^3J = 8.3 Hz, 1 H, 8-H), 5.07 [AB, ^2J = 12.5 Hz, 2 H, 1-OC*H*$_2$(C$_6$H$_5$)], 4.53 (dd, ^3J = 8.3, ^3J = 4.9 Hz, 1 H, 9-H), 4.23 (AB*X*, 1 H, 2-H), 3.75 (s, 3 H, 10-OC*H*$_3$), 3.48 (m, 1 H, 6-H), 2.24 [m, 1 H, 9-C*H*(CH$_3$)$_2$], 1.98 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 1.71 (*AB*X, ^2J = 17.5 Hz, 2 H, 3-H and 3-H′), 1.14 (s, 3 H, Ti−C*H*$_3$), 0.99 and 0.95 [2 × d, 2 × ^3J = 7.1 Hz, 2 × 3 H, 9-CH(C*H*$_3$)(C*H*′$_3$)], 2 × 0.84 [2 × d, 2 × ^3J = 7.2 Hz, 2 × 3 H, 6-CH(C*H*$_3$)(C*H*′$_3$)] ppm. ^{13}C NMR: δ = 178.2 (C-4), 171.9 (C-10), 167.4 (C-7), 156.9 (C-1), 138.8−122.2 {1-OCH$_2$(*C*$_6$H$_5$) and [BPh$_4$]$^-$}, 2 × 116.7 (C-Cp and C-Cp′), 67.7 [1-O*C*H$_2$(C$_6$H$_5$)], 59.5 (C-6), 57.8 (C-9), 52.7 (10-O*C*H$_3$), 52.0 (Ti−*C*H$_3$), 44.9 (C-3), 31.7 [6-*C*H(CH$_3$)$_2$], 31.0 [9-*C*H(CH$_3$)$_2$], 19.0 and 17.9 [9-CH(*C*H$_3$)(*C*H′$_3$)], 18.4 and 17.6 [6-CH(*C*H$_3$)(*C*H′$_3$)] ppm.

Product Z-9(chel^A): Reaction of Z-**9**(pept) (143 mg, 3.39·10^{-4} mol) with **13** (198 mg, 3.39·10^{-4} mol) yielded 305 mg (98%) of Z-**9**(chel^A). M.p. (DSC): 63 °C (dec.). $[\alpha]_D = -23$ (c = 1.0, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3362 (br., NH), 3056 (w), 2963 (m), 1740 (s, COO), 1716 (s, CON), 1703 (s, CON), 1698 (s, CON), 1612 (vs, CON), 1501 (s), 1462 (s), 1268 (m), 1219 (m), 1024 (m), 824 (m), 734 (s), 705 (vs), 613 (w) cm^{-1}. ^{1}H NMR: δ = 8.17 (br., 1 H, 5-H), 7.40 [m, 5 H, 1-OCH$_2$(C$_6$*H*$_5$)], 6.26 (br. d, ^3J = 7.9 Hz, 1 H, 8-H), 6.07 and 6.00 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.15 [AB, ^2J = 12.1 Hz, 2 H, 1-OC*H*$_2$(C$_6$H$_5$)], 4.45 (dd, ^3J = 7.9, ^3J = 4.8 Hz, 1 H, 9-H), 4.29 (AB, 2 H, 3-H and 3-H′), 4.25 (dd, ^3J = 8.5, ^3J = 5.9 Hz, 1 H, 6-H), 3.73 (s, 3 H, 10-OC*H*$_3$), 2.15 [m, 1 H, 9-C*H*(CH$_3$)$_2$], 2.09 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 0.99 and 0.94 [2 × d, 2 × ^3J = 6.8 Hz, 2 × 3 H, 6-CH(C*H*$_3$)(C*H*′$_3$)], 2 × 0.92 [2 × d, 2 × ^3J = 6.8 Hz, 2 × 3 H, 9-CH(C*H*$_3$)(C*H*′$_3$)] ppm. ^{13}C NMR: δ = 175.3 (C-4), 171.8 (C-10), 169.4 (C-7), 151.9 (C-1), 138.8−122.0 {1-OCH$_2$(*C*$_6$H$_5$) and [BPh$_4$]$^-$}, 118.8 and 118.7 (C-Cp and C-Cp′), 68.2 [1-O*C*H$_2$(C$_6$H$_5$)], 60.0 (C-6), 58.0 (C-9), 52.7 (10-O*C*H$_3$), 52.5 (C-3), 32.1 [6-*C*H(CH$_3$)$_2$], 30.9 [9-*C*H(CH$_3$)$_2$], 19.1 and 18.9 [6-CH(*C*H$_3$)(*C*H′$_3$)], 18.0 and 17.8 [9-CH(*C*H$_3$)(*C*H′$_3$)] ppm. $C_{55}H_{60}BN_3O_6Ti$ (917.8): calcd. C 71.98, H 6.59, N 4.58; found C 71.77, H 6.91, N 4.30.

Boc-9(pept) (Boc-Gly-Val-Val-OMe):[14] Reaction of Boc-Gly-Val-OH (6.31 g, 23.0 mmol) with HCl·H-Val-OMe (3.86 g, 23.0 mmol), triethylamine (3.22 mL, 23.0 mmol), and IIDQ (6.98 g, 23.0 mmol) yielded 6.77 g (76%) of Boc-**9**(pept). R_f = 0.30 (ethyl acetate/cyclohexane, 2:1). M.p. (DSC): 215 °C. $[\alpha]_D = -11$ (c = 1.0, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3311 (s, NH), 2967 (m), 2936 (m), 2877 (w), 1747 (m, COO), 1723 (s, CON), 1648 (vs, CON), 1545 (s), 1367 (w), 1299 (m), 1162 (m) cm^{-1}. $C_{18}H_{33}N_3O_6$ (387.5): calcd. C 55.80, H 8.58, N 10.84; found C 55.36, H 8.60, N 10.52.

Reaction of Boc-9(pept) with 13. Boc-9(coord^4): ^{1}H NMR: δ = 7.57 (br., 1 H, 5-H), 6.20 and 6.13 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 6.13 (br. d, ^3J = 4.9 Hz, 1 H, 8-H), 4.54 (dd, ^3J = 8.5, ^3J = 4.9 Hz, 1 H, 9-H), 4.14 (AB*X*, 1 H, 2-H), 3.74 (s, 3 H, 10-OC*H*$_3$), 3.48 (dd, ^3J = 8.8, ^3J = 5.1 Hz, 1 H, 6-H), 2.24 [m, 1 H, 9-C*H*(CH$_3$)$_2$], 1.97 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 1.68 (*AB*X, 2 H, 3-H and 3-H′), 1.42 [s, 9 H, 1-OC(C*H*$_3$)$_3$], 1.13 (s, 3 H, Ti−C*H*$_3$), 0.98 and 0.94 [2 × d, 2 × ^3J = 7.2 Hz, 2 × 3 H, 9-CH(C*H*$_3$C*H*′$_3$)], 0.89 and 0.87 [2 × d, 2 × ^3J = 7.3 Hz, 2 × 3 H, 6-CH(C*H*$_3$C*H*′$_3$)] ppm. ^{13}C NMR: δ = 178.5 (C-4), 171.9 (C-10), 167.6 (C-7), 156.0 (C-1), 116.6 and 116.4 (C-Cp and C-Cp′), 81.5 [1-O*C*(CH$_3$)$_3$], 59.3 (C-6), 57.6 (C-9), 52.7 (10-O*C*H$_3$), 51.6 (Ti−*C*H$_3$), 44.7 (C-3), 32.0 [9-*C*H(CH$_3$)$_2$], 31.1 [6-*C*H(CH$_3$)$_2$], 25.7 [1-OC(*C*H$_3$)$_3$], 19.0, 18.4, 17.8 and 17.6 [6-CH(*C*H$_3$*C*H′$_3$) and 9-CH(*C*H$_3$*C*H′$_3$)] ppm.

Product Boc-9(chel^A): Reaction of Boc-**9**(pept) (102 mg, 2.63·10^{-4} mol) with **13** (154 mg, 2.63·10^{-4} mol) yielded 205 mg (88%) of Boc-**9**(chel^A). M.p. (DSC): 87 °C (dec.). $[\alpha]_D = -17$ (c = 1.0, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3357 (br., NH), 3056 (m), 2965 (s), 1741 (m, COO), 1661 (s, CON), 1616 (vs, CON), 1518 (s), 1496 (s), 1369 (w), 1262 (s), 1208 (w), 1153 (s), 1100 (m), 1018 (vs), 822 (s), 734 (m), 705 (vs), 613 (w) cm^{-1}. ^{1}H NMR: δ = 8.22 (br., 1 H, 5-H), 6.40 (br. d, ^3J = 8.2 Hz, 1 H, 8-H), 6.13 and 6.08 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 4.49 (dd, ^3J = 8.2, ^3J = 4.8 Hz, 1 H, 9-H), 4.28 (dd, ^3J = 8.4, ^3J = 5.8 Hz, 1 H, 6-H), 4.25 (AB, 2 H, 3-H and 3-H′), 3.75 (s, 3 H, 10-OC*H*$_3$), 2.22 [m, 1 H, 9-C*H*(CH$_3$)$_2$], 2.10 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 1.52 [s, 9 H, 1-OC(C*H*$_3$)$_3$], 1.01 and 0.97 [2 × d, 2 × ^3J = 7.7 Hz, 2 × 3 H, 6-CH(C*H*$_3$)(C*H*′$_3$)], 0.98 and 0.96 [2 × d, 2 × ^3J = 7.3 Hz, 2 × 3 H, 9-CH(C*H*$_3$)(C*H*′$_3$)] ppm. ^{13}C NMR: δ = 175.3 (C-4), 171.7 (C-10), 169.5 (C-7), 152.9 (C-1), 118.4 and 118.3 (C-Cp and C-Cp′), 84.3 [1-O*C*(CH$_3$)$_3$], 60.0 (C-6), 58.0 (C-9), 52.7 (C-3), 52.6 (10-O*C*H$_3$), 32.1 [9-*C*H(CH$_3$)$_2$], 31.0 [6-*C*H(CH$_3$)$_2$], 28.7 [1-OC(*C*H$_3$)$_3$], 19.1 and 17.9 [6-CH(*C*H$_3$)(*C*H′$_3$)], 19.0 and 18.0 [9-CH(*C*H$_3$)(*C*H′$_3$)] ppm. $C_{52}H_{62}BN_3O_6Ti$ (883.8): calcd. C 70.67, H 7.07, N 4.75; found C 70.57, H 7.41, N 4.50.

Z-10(pept) (Z-Val-Gly-Val-OMe): Reaction of Z-Val-Gly-OH (1.04 g, 3.37 mmol) with HCl·H-Val-OMe (566 mg, 3.37 mmol), triethylamine (0.47 mL, 3.37 mmol), and IIDQ (1.02 g, 3.37 mmol) yielded 1.15 g (81%) of Z-**10**(pept). R_f = 0.22 (ethyl acetate/cyclohexane, 3:1). M.p. (DSC): 128 °C. $[\alpha]_D = +4$ (c = 1.0, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3298 (br. s, NH), 2964 (m), 1742 (s, COO), 1693 (s, CON), 1644 (vs, CON), 1539 (s), 1393 (w), 1292 (m), 1246 (s), 1039 (w), 699 (m) cm^{-1}. $C_{21}H_{31}N_3O_6$ (421.5): calcd. C 59.84, H 7.41, N 9.97; found C 59.93, H 7.73, N 9.61.

Reaction of Z-10(pept) with 13. Z-10(coord^7): ^{1}H NMR: δ = 8.18 (br. d, ^3J = 9.2 Hz, 1 H, 8-H), 7.36 [m, 5 H, 1-OCH$_2$(C$_6$*H*$_5$)], 6.19 and 6.18 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.26 (AB*X*, 1 H, 5-H), 5.20 (br., 1 H, 2-H), 5.11 [AB, ^2J = 12.1 Hz, 2 H, 1-OC*H*$_2$(C$_6$H$_5$)], 3.83 (s, 3 H, 10-OC*H*$_3$), 3.47 (m, 1 H, 9-H), 3.40 (dd, ^3J = 6.5, ^3J = 4.6 Hz, 1 H, 3-H), 2.28 (*AB*X, ^2J = 17.9 Hz, 2 H, 6-H and 6-H′), 2.15 [m, 1 H, 9-C*H*(CH$_3$)$_2$], 1.95 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 1.13 (s, 3 H, Ti−C*H*$_3$), 0.93 and 0.90 [2 × d, 2 × ^3J = 7.2 Hz, 2 × 3 H, 3-CH(C*H*$_3$)(C*H*′$_3$)], 0.87 and 0.85 [2 × d, 2 × ^3J = 7.2 Hz, 2 × 3 H, 9-CH(C*H*$_3$)(C*H*′$_3$)] ppm. ^{13}C NMR: δ = 178.2 (C-7), 172.1 (C-4), 169.1 (C-10), 157.1 (C-1), 135.8−122.3 {1-OCH$_2$(*C*$_6$H$_5$) and [BPh$_4$]$^-$}, 116.6 and 116.5 (C-Cp and C-Cp′), 67.6 [1-O*C*H$_2$(C$_6$H$_5$)], 61.0 (C-3), 60.1 (C-9), 53.0 (10-O*C*H$_3$), 52.1 (Ti−*C*H$_3$), 43.1 (C-6), 30.0 [9-*C*H(CH$_3$)$_2$], 29.6 [3-*C*H(CH$_3$)$_2$], 19.4 and 18.7 [3-CH(*C*H$_3$)(*C*H′$_3$)], 18.5 and 18.3 [9-CH(*C*H$_3$)(*C*H′$_3$)] ppm.

Product: Z-10(chel^B): Reaction of Z-**10**(pept) (156 mg, 3.70·10^{-4} mol) with **13** (216 mg, 3.70·10^{-4} mol) yielded 326 mg (96%) of orange Z-**10**(chel^B). M.p. (DSC): 48 °C (dec.). $[\alpha]_D = -33$ (c = 1.0, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3360 (br., NH), 3055 (w),

2965 (m), 1741 (s, COO), 1718 (s, CON), 1701 (s, CON), 1696 (s, CON), 1617 (vs, CON), 1497 (s), 1465 (s), 1263 (m), 1220 (m), 1026 (m), 825 (m), 734 (s), 706 (vs), 613 (w) cm^{-1}. ^1H NMR: δ = 7.36 [m, 5 H, 1-OCH$_2$(C$_6$*H*$_5$)], 7.35 (br. d, ^3J = 8.1 Hz, 1 H, 8-H), 6.10 and 6.02 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.41 (br. d, ^3J = 7.0 Hz, 1 H, 2-H), 5.11 [AB, ^2J = 12.2 Hz, 2 H, 1-OC*H*$_2$(C$_6$H$_5$)], 4.26 (m, ^3J = 8.1, ^3J = 5.4 Hz, 1 H, 9-H), 3.96 (AB, ^2J = 19.2 Hz, 2 H, 6-H and 6-H′), 3.74 (s, 3 H, 10-OC*H*$_3$), 3.64 (m, 1 H, 3-H), 2.15 [m, 1 H, 9-C*H*(CH$_3$)$_2$], 1.88 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 0.98 and 0.96 [2 × d, 2 × ^3J = 7.3 Hz, 2 × 3 H, 3-CH(C*H*$_3$)(C*H*′$_3$)], 0.97 and 0.94 [2 × d, 2 × ^3J = 7.5 Hz, 2 × 3 H, 9-CH(C*H*$_3$)(C*H*′$_3$)] ppm. ^{13}C NMR: δ = 174.9 (C-7), 173.9 (C-4), 170.3 (C-10), 156.5 (C-1), 138.8−122.2 {1-OCH$_2$(*C*$_6$H$_5$) and [BPh$_4$]$^-$}, 118.3 and 118.2 (C-Cp and C-Cp′), 67.4 [1-O*C*H$_2$(C$_6$H$_5$)], 59.7 (C-9), 59.2 (C-3), 53.0 (10-O*C*H$_3$), 52.2 (C-6), 30.9 [9-*C*H(CH$_3$)$_2$], 29.0 [3-*C*H(CH$_3$)$_2$], 19.4 and 18.9 [3-CH(*C*H$_3$)(*C*H′$_3$)], 18.3 and 18.0 [9-CH(*C*H$_3$)(*C*H′$_3$)] ppm. $C_{55}H_{60}BN_3O_6Ti$ (917.8): calcd. C 71.98, H 6.59, N 4.58; found C 71.76, H 6.79, N 4.44.

Boc-10(pept) (Boc-Val-Gly-Val-OMe): Reaction of Boc-Val-Gly-OH (5.79 g, 21.1 mmol) with HCl·H-Val-OMe (3.54 g, 21.1 mmol), triethylamine (2.95 mL, 21.1 mmol), and IIDQ (6.40 g, 21.1 mmol) yielded 4.66 g (57%) of Boc-**10**(pept). R_f = 0.29 (ethyl acetate/cyclohexane, 2:1). M.p. (DSC): 226 °C. [α]$_D$ = −2 (*c* = 1.0, CH_2Cl_2). IR (KBr): ṽ = 3333 (br. m, NH), 2967 (m), 1747 (s, COO), 1693 (s, CON), 1648 (vs, CON), 1526 (s), 1392 (w), 1299 (m), 1172 (s), 1017 (w) cm^{-1}. $C_{18}H_{33}N_3O_6$ (387.5): calcd. C 55.80, H 8.58, N 10.84; found C 55.84, H 8.91, N 10.24.

Reaction of Boc-10(pept) with 13. Boc-10(coord^7): ^1H NMR: δ = 8.24 (br. d, ^3J = 9.1 Hz, 1 H, 8-H), 6.19 and 6.16 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.60 (AB*X*, 1 H, 5-H), 4.90 (br. d, ^3J = 4.5 Hz, 1 H, 2-H), 3.80 (s, 3 H, 10-OC*H*$_3$), 3.46 (m, 1 H, 9-H), 3.42 (m, 1 H, 3-H), 2.19 (*AB*X, ^2J = 12.0 Hz, 2 H, 6-H and 6-H′), 2.15 [m, 1 H, 9-C*H*(CH$_3$)$_2$], 2.05 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 1.48 [s, 9 H, 1-OC(C*H*$_3$)$_3$], 1.13 (s, 3 H, Ti−C*H*$_3$), 0.95 and 0.87 [2 × d, 2 × ^3J = 7.2 Hz, 2 × 3 H, 3-CH(C*H*$_3$C*H*′$_3$)], 0.89 and 0.88 [2 × d, 2 × ^3J = 7.2 Hz, 2 × 3 H, 9-CH(C*H*$_3$C*H*′$_3$)] ppm. ^{13}C NMR: δ = 178.4 (C-7), 171.8 (C-4), 168.9 (C-10), 156.8 (C-1), 116.7 and 116.5 (C-Cp and C-Cp′), 81.8 [1-O*C*(CH$_3$)$_3$], 60.3 (C-3), 60.0 (C-9), 52.8 (10-O*C*H$_3$), 51.9 (Ti−*C*H$_3$), 43.0 (C-6), 29.8 and 29.7 [3-*C*H(CH$_3$)$_2$ and 9-*C*H(CH$_3$)$_2$], 25.6 [1-OC(*C*H$_3$)$_3$], 19.5, 18.7, 18.5 and 17.8 [3-CH(*C*H$_3$*C*H′$_3$) and 9-CH(*C*H$_3$*C*H′$_3$)] ppm.

Product Boc-10(chel^B): Reaction of Boc-**10**(pept) (132 mg, 3.41·10^{-4} mol) with **13** (199 mg, 3.41·10^{-4} mol) yielded 268 mg (89%) of Boc-**10**(chel^B). M.p. (DSC): 85 °C (dec.). [α]$_D$ = −66 (*c* = 0.70, CH_2Cl_2). IR (KBr): ṽ = 3371 (br., NH), 3055 (w), 2966 (m), 1741 (m, COO), 1703 (s, CON), 1620 (vs, CON), 1481 (s), 1448 (w), 1369 (w), 1261 (m), 1154 (s), 1109 (m), 1017 (s), 823 (s), 734 (m), 706 (vs), 612 (w) cm^{-1}. ^1H NMR: δ = 7.02 (br. d, ^3J = 8.1 Hz, 1 H, 8-H), 6.12 and 6.09 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 4.95 (br. d, ^3J = 6.8 Hz, 1 H, 2-H), 4.25 (dd, ^3J = 8.1, ^3J = 5.4 Hz, 1 H, 9-H), 3.98 (AB, ^2J = 18.9 Hz, 2 H, 6-H and 6-H′), 3.73 (s, 3 H, 10-OC*H*$_3$), 3.52 (dd, ^3J = 7.1, ^3J = 6.8 Hz, 1 H, 3-H), 2.15 [m, 1 H, 9-C*H*(CH$_3$)$_2$], 1.83 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 1.45 [s, 9 H, 1-OC(C*H*$_3$)$_3$], 0.97 and 0.96 [2 × d, 2 × ^3J = 6.9 Hz, 2 × 3 H, 3-CH(C*H*$_3$)(C*H*′$_3$)], 0.97 and 0.94 [2 × d, 2 × ^3J = 7.5 Hz, 2 × 3 H, 9-CH(C*H*$_3$)(C*H*′$_3$)] ppm. ^{13}C NMR: δ = 174.9 (C-7), 174.6 (C-4), 170.2 (C-10), 156.0 (C-1), 118.4 and 118.3 (C-Cp and C-Cp′), 80.5 [1-O*C*(CH$_3$)$_3$], 59.7 (C-9), 58.6 (C-3), 53.0 (10-O*C*H$_3$), 52.2 (C-6), 30.9 [9-*C*H(CH$_3$)$_2$], 28.9 [3-*C*H(CH$_3$)$_2$], 28.2 [1-OC(*C*H$_3$)$_3$], 19.4 and 18.5 [3-CH(*C*H$_3$)(*C*H′$_3$)], 18.9 and 18.0 [9-CH(*C*H$_3$)(*C*H′$_3$)] ppm. $C_{52}H_{62}BN_3O_6Ti$ (883.8): calcd. C 70.67, H 7.07, N 4.75; found C 70.38, H 7.36, N 4.53.

Z-11(pept) (Z-Val-Val-Gly-OMe):[38] Reaction of Z-Val-Val-OH (0.99 g, 2.83 mmol) with HCl·H-Gly-OMe (352 mg, 2.83 mmol), triethylamine (0.40 mL, 2.83 mmol), and IIDQ (857 mg, 2.83 mmol) gave 0.99 g (83%) of Z-**11**(pept). M.p. (DSC): 190 °C. [α]$_D$ = −18 (*c* = 0.80, CH_2Cl_2). IR (KBr): ṽ = 3293 (br. s, NH), 2962 (m), 1755 (m, COO), 1693 (s, CON), 1641 (vs, CON), 1540 (s), 1393 (w), 1295 (m), 1247 (s), 1042 (m), 699 (s) cm^{-1}. $C_{21}H_{31}N_3O_6$ (421.5): calcd. C 59.84, H 7.41, N 9.97; found C 59.23, H 7.44, N 9.82.

Reaction of Z-11(pept) with 13. Z-11(coord^7): ^1H NMR: δ = 8.95 (AB*X*, 1 H, 8-H), 7.35 [m, 5 H, 1-OCH$_2$(C$_6$*H*$_5$)], 6.32 (br., 1 H, 5-H), 6.29 and 6.25 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.38 (br., 1 H, 2-H), 5.11 [AB, ^2J = 12.0 Hz, 2 H, 1-OC*H*$_2$(C$_6$H$_5$)], 3.86 (m, 1 H, 3-H), 3.82 (s, 3 H, 10-OC*H*$_3$), 3.82 (m, 1 H, 6-H), 3.63 (*AB*X, ^2J = 17.6 Hz, 2 H, 9-H and 9-H′), 2.20 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 1.83 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 1.17 (s, 3 H, Ti−C*H*$_3$), 1.02 and 0.97 [2 × d, 2 × ^3J = 7.0 Hz, 2 × 3 H, 3-CH(C*H*$_3$)(C*H*′$_3$)], 0.92 and 0.74 [2 × d, 2 × ^3J = 6.9 Hz, 2 × 3 H, 6-CH(C*H*$_3$)(C*H*′$_3$)] ppm. ^{13}C NMR: δ = 182.5 (C-7), 171.6 (C-4), 164.5 (C-10), 158.9 (C-1), 138.8−122.0 {1-OCH$_2$(*C*$_6$H$_5$) and [BPh$_4$]$^-$}, 116.9 and 116.8 (C-Cp and C-Cp′), 68.5 [1-O*C*H$_2$(C$_6$H$_5$)], 62.5 (C-3), 58.5 (C-6), 53.4 (10-O*C*H$_3$), 51.5 (Ti−*C*H$_3$), 42.1 (C-9), 29.7 [3-*C*H(CH$_3$)$_2$], 28.7 [6-*C*H(CH$_3$)$_2$], 19.6 and 19.0 [6-CH(*C*H$_3$)(*C*H′$_3$)], 17.8 and 15.7 [3-CH(*C*H$_3$)(*C*H′$_3$)] ppm.

Products Z-11(chel^A)/Z-11(chel^B) = 2:3: Reaction of Z-**11**(pept) (122 mg, 2.89·10^{-4} mol) with **13** (169 mg, 2.89·10^{-4} mol) yielded 247 mg (93%) of the isomeric mixture Z-**11**(chel^A)/Z-**11**(chel^B) = 2:3. M.p. (DSC): 81 °C (dec.). [α]$_D$ = −32 (*c* = 0.70, CH_2Cl_2). IR (KBr): ṽ = 3368 (br., NH), 3055 (w), 2966 (w), 1751 (m, COO), 1713 (vs, CON), 1622 (vs, CON), 1580 (m), 1481 (s), 1439 (s), 1362 (m), 1261 (m), 1215 (m), 1096 (m), 1026 (s), 822 (s), 735 (vs), 706 (vs), 613 (w) cm^{-1}. $C_{55}H_{60}BN_3O_6Ti$ (917.8): calcd. C 71.98, H 6.59, N 4.58; found C 71.70, H 6.80, N 4.42. **Z-11(chel^A):** ^1H NMR: δ = 7.37 [m, 5 H, 1-OCH$_2$(C$_6$*H*$_5$)], 7.35 (br. d, ^3J = 9.7 Hz, 1 H, 5-H), 5.81 (AB*X*, 1 H, 8-H), 6.17 and 5.89 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.19 [AB, ^2J = 12.1 Hz, 2 H, 1-OC*H*$_2$(C$_6$H$_5$)], 4.50 (d, ^3J = 2.8 Hz, 1 H, 3-H), 4.11 (dd, ^3J = 8.1, ^3J = 5.6 Hz, 1 H, 6-H), 3.81 (*AB*X, ^2J = 18.3 Hz, 2 H, 9-H and 9-H′), 3.71 (s, 3 H, 10-OC*H*$_3$), 2.34 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 2.03 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 1.14 and 1.09 [2 × d, 2 × ^3J = 6.9 Hz, 2 × 3 H, 3-CH(C*H*$_3$)(C*H*′$_3$)], 0.98 and 0.96 [2 × d, 2 × ^3J = 6.9 Hz, 2 × 3 H, 6-CH(C*H*$_3$)(C*H*′$_3$)] ppm. ^{13}C NMR: δ = 178.0 (C-4), 169.8 (C-7), 168.9 (C-10), 153.2 (C-1), 138.8−122.1 {1-OCH$_2$(*C*$_6$H$_5$) and [BPh$_4$]$^-$}, 119.4 and 117.8 (C-Cp and C-Cp′), 69.3 (C-3), 68.6 [1-O*C*H$_2$(C$_6$H$_5$)], 59.8 (C-6), 52.7 (10-O*C*H$_3$), 41.3 (C-9), 34.4 [3-*C*H(CH$_3$)$_2$], 31.4 [6-*C*H(CH$_3$)$_2$], 22.6−14.1 [3-CH(*C*H$_3$)(*C*H′$_3$) and 6-CH(*C*H$_3$)(*C*H′$_3$)] ppm. **Z-11(chel^B):** ^1H NMR: δ = 7.37 [m, 5 H, 1-OCH$_2$(C$_6$*H*$_5$)], 6.14 (AB*X*, 1 H, 8-H), 6.13 and 5.89 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.64 (br., 1 H, 2-H), 5.12 (AB, ^2J = 12.1 Hz, 2 H, 1-OC*H*$_2$(C$_6$H$_5$)], 5.00 (d, ^3J = 3.1 Hz, 1 H, 6-H), 4.03 (m, 1 H, 3-H), 3.75 (s, 3 H, 10-OC*H*$_3$), 3.43 (*AB*X, ^2J = 18.0 Hz, 2 H, 9-H and 9-H′), 2.12 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 2.03 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 0.95 and 0.91 [2 × d, 2 × ^3J = 7.2 Hz, 2 × 3 H, 3-CH(C*H*$_3$)(C*H*′$_3$)] ppm. ^{13}C NMR: δ = 177.7 (C-7), 175.1 (C-4), 168.4 (C-10), 156.5 (C-1), 138.8−122.1 {1-OCH$_2$(*C*$_6$H$_5$) and [BPh$_4$]$^-$}, 118.5 and 117.8 (C-Cp and C-Cp′), 69.3 (C-6), 67.6 [1-O*C*H$_2$(C$_6$H$_5$)], 58.3 (C-3), 53.0 (10-O*C*H$_3$), 42.4 (C-9), 35.5 [6-*C*H(CH$_3$)$_2$], 29.2 [3-*C*H(CH$_3$)$_2$], 22.6−14.1 [3-CH(*C*H$_3$)(*C*H′$_3$) and 6-CH(*C*H$_3$)(*C*H′$_3$)] ppm.

Boc-11(pept) (Boc-Val-Val-Gly-OMe):[14] Reaction of Boc-Val-Val-OH (3.64 g, 11.5 mmol) with HCl·H-Gly-OMe (1.43 g, 11.5 mmol), triethylamine (1.60 mL, 11.5 mmol), and IIDQ (3.49 g, 11.5 mmol) yielded 3.16 g (71%) of Boc-**11**(pept). R_f = 0.43 (ethyl acetate/

cyclohexane, 3:1). M.p. (DSC): 176 °C. $[\alpha]_D = -35$ ($c = 1.0$, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3295 (s, NH), 2967 (s), 2933 (m), 1759 (m, COO), 1695 (s, CON), 1640 (vs, CON), 1554 (s), 1526 (s), 1393 (w), 1365 (m), 1209 (m), 1179 (m), 781 (s) cm^{-1}. ^1H NMR: δ = 7.62 (AB*X*, 1 H, 8-H), 7.23 (br. d, ^3J = 8.9 Hz, 1 H, 5-H), 5.62 (br. d, ^3J = 6.6 Hz, 1 H, 2-H), 4.36 (dd, ^3J = 8.9, ^3J = 6.8 Hz, 1 H, 6-H), 3.98 (*AB*X, 2 H, 9-H and 9-H′), 3.98 (m, 1 H, 3-H), 3.67 (s, 3 H, 10-OCH_3), 2.15 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 2.05 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 1.38 [s, 9 H, 1-OC(CH_3)$_3$], 0.95−0.94 [m, 4 × 3 H, 3-CH(CH_3C*H*′$_3$) and 6-CH(CH_3C*H*′$_3$)] ppm. ^{13}C NMR: δ = 172.1 (C-4), 171.8 (C-7), 170.2 (C-10), 156.2 (C-1), 79.9 [1-O*C*(CH$_3$)$_3$], 60.4 (C-3), 58.2 (C-6), 52.3 (10-O*C*H$_3$), 41.0 (C-9), 30.5 [3-*C*H(CH$_3$)$_2$], 30.4 [6-*C*H(CH$_3$)$_2$], 28.0 [1-OC(*C*H$_3$)$_3$], 19.1 and 19.0 [6-CH(*C*H$_3$C*H*′$_3$)], 17.9 and 17.6 [3-CH(*C*H$_3$C*H*′$_3$)] ppm. $C_{18}H_{33}N_3O_6$ (387.5): calcd. C 55.80, H 8.58, N 10.84; found C 55.81, H 8.61, N 10.63.

Reaction of Boc-11(pept) with 13. Boc-11(coord^7): ^1H NMR: δ = 9.45 (AB*X*, 1 H, 8-H), 6.49 (br. d, ^3J = 6.1 Hz, 1 H, 5-H), 6.27 and 6.23 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.26 (br., 1 H, 2-H), 3.91 (m, 1 H, 6-H), 3.81 (m, 1 H, 3-H), 3.79 (s, 3 H, 10-OCH_3), 3.67 (*AB*X, ^2J = 19.6 Hz, 2 H, 9-H and 9-H′), 2.19 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 1.93 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 1.43 [s, 9 H, 1-OC(CH_3)$_3$], 1.18 (s, 3 H, Ti−CH_3), 1.03 and 0.99 [2 × d, 2 × ^3J = 7.0 Hz, 2 × 3 H, 3-CH(CH_3C*H*′$_3$)], 1.00 and 0.95 [2 × d, 2 × ^3J = 7.2 Hz, 2 × 3 H, 6-CH(CH_3C*H*′$_3$)] ppm. ^{13}C NMR: δ = 182.5 (C-7), 171.9 (C-4), 167.3 (C-10), 158.4 (C-1), 116.9 and 116.7 (C-Cp and C-Cp′), 82.7 [1-O*C*(CH$_3$)$_3$], 62.0 (C-3), 58.2 (C-6), 53.3 (10-O*C*H$_3$), 51.1 (Ti−*C*H$_3$), 41.9 (C-9), 29.5 [6-*C*H(CH$_3$)$_2$], 28.5 [3-*C*H(CH$_3$)$_2$], 27.9 [1-OC(*C*H$_3$)$_3$], 19.6, 18.9, 17.8 and 15.3 [3-CH(*C*H$_3$C*H*′$_3$) and 6-CH(*C*H$_3$C*H*′$_3$)] ppm.

Products Boc-11(chel^A)/Boc-11(chel^B) = 2:3: Reaction of Boc-**11**(pept) (149 mg, 3.85·10^{-4} mol) with **13** (225 mg, 3.85·10^{-4} mol) yielded 316 mg (93%) of the isomeric mixture Boc-**11**(chel^A)/Boc-**11**(chel^B) = 2:3. M.p. (DSC): 41 °C (dec.). $[\alpha]_D = -104$ (c = 0.90, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3375 (br., NH), 3056 (m), 2967 (s), 1751 (m, COO), 1662 (s, CON), 1607 (vs, CON), 1540 (s), 1481 (s), 1449 (s), 1369 (m), 1206 (w), 1152 (m), 1015 (w), 822 (m), 734 (s), 706 (vs), 613 (m) cm^{-1}. $C_{52}H_{62}BN_3O_6Ti$ (883.8): calcd. C 70.67, H 7.07, N 4.75; found C 71.18, H 8.10, N 4.23. **Boc-11(chel^A):** ^1H NMR: δ = 7.29 (br. d, ^3J = 8.2 Hz, 1 H, 5-H), 6.13 and 5.98 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.76 (AB*X*, 1 H, 8-H), 5.05 (d, ^3J = 3.1 Hz, 1 H, 3-H), 4.12 (dd, ^3J = 8.2, ^3J = 5.6 Hz, 1 H, 6-H), 3.78 (*AB*X, ^2J = 18.0 Hz, 2 H, 9-H and 9-H′), 3.74 (s, 3 H, 10-OCH_3), 2.09 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 2.03 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 1.46 [s, 9 H, 1-OC(CH_3)$_3$], 1.18 and 1.12 [2 × d, 2 × ^3J = 7.4 Hz, 2 × 3 H, 3-CH(CH_3)(C*H*′$_3$)], 0.99 and 0.98 [2 × d, 2 × ^3J = 7.2 Hz, 2 × 3 H, 6-CH(CH_3)(C*H*′$_3$)] ppm. ^{13}C NMR: δ = 177.9 (C-4), 169.7 (C-10), 168.9 (C-7), 155.9 (C-1), 118.5 and 118.0 (C-Cp and C-Cp′), 84.8 [1-O*C*(CH$_3$)$_3$], 69.3 (C-3), 59.7 (C-6), 52.9 (10-O*C*H$_3$), 41.3 (C-9), 35.6 [3-*C*H(CH$_3$)$_2$], 31.5 [6-*C*H(CH$_3$)$_2$], 28.3 [1-OC(*C*H$_3$)$_3$], 19.7 and 17.6 [6-CH(*C*H$_3$)(*C*H′$_3$)], 19.5 and 17.8 [3-CH(*C*H$_3$)(*C*H′$_3$)] ppm. **Boc-11(chel^B):** ^1H NMR: δ = 6.18 and 6.07 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.98 (AB*X*, 1 H, 8-H), 5.08 (br. d, ^3J = 7.3 Hz, 1 H, 2-H), 4.48 (d, ^3J = 3.0 Hz, 1 H, 6-H), 3.71 (s, 3 H, 10-OCH_3), 3.62 (dd, ^3J = 9.5, ^3J = 7.3 Hz, 1 H, 3-H), 3.35 (*AB*X, ^2J = 17.7 Hz, 2 H, 9-H and 9-H′), 2.29 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 1.93 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 1.54 [s, 9 H, 1-OC(CH_3)$_3$], 1.15 and 1.08 [2 × d, 2 × ^3J = 7.3 Hz, 2 × 3 H, 6-CH(CH_3)(C*H*′$_3$)], 1.06 and 0.99 [2 × d, 2 × ^3J = 7.2 Hz, 2 × 3 H, 3-CH(CH_3)(C*H*′$_3$)] ppm. ^{13}C NMR: δ = 178.1 (C-7), 175.6 (C-4), 168.3 (C-10), 154.1 (C-1), 119.1 and 117.5 (C-Cp and C-Cp′), 80.8 [1-O*C*(CH$_3$)$_3$], 69.3 (C-6), 58.0 (C-3), 52.6 (10-O*C*H$_3$), 42.4 (C-9), 34.6 (6-*C*H(CH$_3$)$_2$], 29.1 [3-*C*H(CH$_3$)$_2$], 28.6 [1-OC(*C*H$_3$)$_3$], 20.3 and 17.9 [6-CH(*C*H$_3$)(*C*H′$_3$)], 18.9 and 18.7 [3-CH(*C*H$_3$)(*C*H′$_3$)] ppm.

Z-12(pept) (Z-Val-Val-Val-OMe):[39] Reaction of Z-Val-Val-OH (1.00 g, 2.85 mmol) with HCl·H-Val-OMe (478 mg, 2.85 mmol), triethylamine (0.40 mL, 2.85 mmol), and IIDQ (866 mg, 2.85 mmol): Yield 1.12 g (85%) Z-**12**(pept). R_f = 0.24 (ethyl acetate/cyclohexane, 3:1). M.p. (DSC): 225 °C. $[\alpha]_D = -28$ (c = 1.0, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3290 (br. s, NH), 2963 (m), 1734 (m, COO), 1691 (s, CON), 1640 (vs, CON), 1539 (s), 1394 (w), 1294 (w), 1248 (m), 1041 (w), 699 (m) cm^{-1}. $C_{24}H_{37}N_3O_6$ (463.6): calcd. C 62.18, H 8.05, N 9.06; found C 61.67, H 8.06, N 8.85.

Reaction of Z-12(pept) with 13

Z-12(coord^4)/Z-12(coord^7) = 1:3. Z-12(coord^4): ^1H NMR: δ = 7.37 [m, 5 H, 1-OCH$_2$(C$_6H_5$)], 6.82 (br., 1 H, 8-H), 6.66 (br., 1 H, 5-H), 6.18 and 6.16 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.83 (br., 1 H, 2-H), 4.84 [AB, ^2J = 12.4 Hz, 2 H, 1-OCH_2(C$_6H_5$)], 4.53 (dd, ^3J = 8.8, ^3J = 5.0 Hz, 1 H, 6-H), 4.44 (m, 1 H, 9-H), 4.11 (m, 1 H, 3-H), 3.70 (s, 3 H, 10-OCH_3), 2.18 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 2.08 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 2.03 [m, 1 H, 9-C*H*(CH$_3$)$_2$], 1.25 (s, 3 H, Ti−CH_3), 0.96−0.86 [3-CH(CH_3C*H*′$_3$), 6-CH(CH_3C*H*′$_3$) and 9-CH(CH_3C*H*′$_3$)] ppm. ^{13}C NMR: δ = 117.5 and 117.4 (C-Cp and C-Cp′), 71.4 [1-OCH$_2$(C$_6$H$_5$)], 60.9 (C-3), 58.9 (C-9), 57.5 (C-6), 54.7 (10-O*C*H$_3$), 52.5 (Ti−*C*H$_3$), 31.8, 31.2 and 30.4 [3-*C*H(CH$_3$)$_2$, 6-*C*H(CH$_3$)$_2$ and 9-*C*H(CH$_3$)$_2$], 19.1−17.4 [3-CH(*C*H$_3$C*H*′$_3$), 6-CH(*C*H$_3$C*H*′$_3$) and 9-CH(*C*H$_3$C*H*′$_3$)] ppm (C-1, C-4, C-7 and C-10 signals not observed). **Z-12(coord^7):** ^1H NMR: δ = 8.85 (br. d, ^3J = 9.4 Hz, 1 H, 8-H), 7.37 [m, 5 H, 1-OCH$_2$(C$_6H_5$)], 6.45 (br., 1 H, 2-H), 6.29 and 6.27 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.40 (br., 1 H, 5-H), 5.11 [AB, ^2J = 10.8 Hz, 2 H, 1-OCH_2(C$_6H_5$)], 3.93 (m, 1 H, 6-H), 3.81 (s, 3 H, 10-OCH_3), 3.80 (m, 1 H, 3-H), 3.65 (dd, ^3J = 9.4, ^3J = 7.0 Hz, 1 H, 9-H), 2.30 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 2.27 [m, 1 H, 9-C*H*(CH$_3$)$_2$], 1.85 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 1.21 (s, 3 H, Ti−CH_3), 1.05 and 0.98 [2 × d, 2 × ^3J = 7.0 Hz, 2 × 3 H, 6-CH(CH_3C*H*′$_3$)], 0.96 and 0.95 [2 × d, 2 × ^3J = 7.1 Hz, 2 × 3 H, 9-CH(CH_3C*H*′$_3$)], 0.94 and 0.74 [2 × d, 2 × ^3J = 6.8 Hz, 2 × 3 H, 3-CH(CH_3C*H*′$_3$)] ppm. ^{13}C NMR: δ = 181.7 (C-7), 171.5 (C-4), 168.9 (C-10), 158.4 (C1), 138.8−121.9 {1-OCH$_2$(*C*$_6$H$_5$) and [BPh$_4$]$^-$}, 116.9 and 116.8 (C-Cp and C-Cp′), 68.2 [1-O*C*H$_2$(C$_6$H$_5$)], 62.1 (C-6), 60.1 (C-9), 59.1 (C-3), 53.2 (10-O*C*H$_3$), 51.9 (Ti−*C*H$_3$), 30.4 [9-*C*H(CH$_3$)$_2$], 29.6 [6-*C*H(CH$_3$)$_2$], 28.6 [3-*C*H(CH$_3$)$_2$], 19.6, 19.1, 19.1, 18.6, 17.4 and 16.4 [3-CH(*C*H$_3$C*H*′$_3$), 6-CH(*C*H$_3$C*H*′$_3$) and 9-CH(*C*H$_3$C*H*′$_3$)] ppm.

Products Z-12(chel^A)/Z-12(chel^B) = 1:1: Reaction of Z-**12**(pept) (164 mg, 3.54·10^{-4} mol) with **13** (207 mg, 3.54·10^{-4} mol) yielded 319 mg (94%) of the isomeric mixture Z-**12**(chel^A)/Z-**12**(chel^B) = 1:1. M.p. (DSC): 91 °C (dec.). $[\alpha]_D = -86$ (c = 0.60, CH_2Cl_2). IR (KBr): $\tilde{\nu}$ = 3369 (br., NH), 3055 (w), 2966 (s), 1740 (m, COO), 1715 (m, CON), 1651 (vs, CON), 1606 (s), 1580 (w), 1516 (m), 1481 (s), 1439 (m), 1263 (m), 1215 (w), 1096 (w), 1026 (m), 822 (m), 735 (s), 706 (vs), 613 (w) cm^{-1}. $C_{58}H_{66}N_3BO_6Ti$ (959.9): calcd. C 72.57, H 6.93, N 4.38; found C 71.59, H 6.72, N 4.35. **Z-12(chel^A):** ^1H NMR: δ = 7.76 (br., 1 H, 5-H), 7.36 [m, 5 H, 1-OCH$_2$(C$_6H_5$)], 6.31 (br., 1 H, 8-H), 6.16 and 6.15, 5.90 and 5.87 (each 2 × s, each 2 × 5 H, each Cp-H and Cp′-H), 5.19 [AB, ^2J = 12.2 Hz, 2 H, 1-OCH_2(C$_6H_5$)], 4.55 (dd, ^3J = 8.5, ^3J = 4.8 Hz, 1 H, 9-H), 4.52 (d, ^3J = 3.4 Hz, 1 H, 3-H), 4.20 (dd, ^3J = 9.3, ^3J = 6.7 Hz, 1 H, 6-H), 3.75 (s, 3 H, 10-OCH_3), 2.34 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 2.21 [m, 1 H, 9-C*H*(CH$_3$)$_2$], 2.11 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 1.11 and 1.04 [2 × d, 2 × ^3J = 7.2 Hz, 2 × 3 H, 3-CH(CH_3)(C*H*′$_3$)], 1.00 and 0.99 [2 × d, 2 × ^3J = 7.2 Hz, 2 × 3 H, 6-CH(CH_3)(C*H*′$_3$)], 0.93 and 0.91 [2 × d, 2 × ^3J = 7.4 Hz, 2 × 3 H, 9-CH(CH_3)(C*H*′$_3$)] ppm. ^{13}C

NMR: δ = 178.0 (C-4), 171.8 (C-10), 168.9 (C-7), 153.4 (C-1), 138.8−121.9 {1-OCH$_2$(C_6H$_5$) and [BPh$_4$]$^-$}, 119.2 and 118.8, 117.9 and 117.8 (each C-Cp and C-Cp′), 69.3 (C-3), 68.7 [1-O*C*H$_2$(C$_6$H$_5$)], 60.2 (C-6), 57.6 (C-9), 52.8 (10-O*C*H$_3$), 31.6 (6-*C*H(CH$_3$)$_2$], 31.0 [9-*C*H(CH$_3$)$_2$], 30.8 [3-*C*H(CH$_3$)$_2$], 21.4−17.2 [3-CH(*C*H$_3$)(*C*H′$_3$), 6-CH(*C*H$_3$)(*C*H′$_3$), 9-CH(*C*H$_3$)(*C*H′$_3$)] ppm. **Z-12(chel^B):** ^{1}H NMR: δ = 7.36 [m, 5 H, 1-OCH$_2$(C$_6$*H*$_5$)], 6.19 (br., 1 H, 2-H), 6.16 and 6.15, 5.90 and 5.87 (each 2 × s, each 2 × 5 H, Cp-H and Cp′-H of isomer A and B), 5.40 (br. d, ^3J = 7.4 Hz, 1 H, 8-H), 5.16 (br., 1 H, 6-H), 5.05 [AB, ^2J = 12.5 Hz, 2 H, 1-O*C*H$_2$(C$_6$H$_5$)], 4.15 (m, 1 H, 3-H), 3.82 (s, 3 H, 10-OC*H*$_3$), 3.67 (m, 1 H, 9-H), 2.33 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 2.01 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 1.98 [m, 1 H, 9-C*H*(CH$_3$)$_2$], 1.38 and 1.17 [2 × d, 2 × ^3J = 7.2 Hz, 2 × 3 H, 6-CH(C*H*$_3$)(C*H*′$_3$)], 1.06 and 1.00 [2 × d, 2 × ^3J = 7.2 Hz, 2 × 3 H, 9-CH(C*H*$_3$)(C*H*′$_3$)], 0.89 and 0.87 [2 × d, 2 × ^3J = 7.3 Hz, 2 × 3 H, 3-CH(C*H*$_3$)(C*H*′$_3$)] ppm. ^{13}C NMR: δ = 177.5 (C-4), 175.1 (C-7), 172.4 (C-10), 156.3 (C-1), 138.8−121.9 {1-OCH$_2$(C_6H$_5$) and [BPh$_4$]$^-$}, 119.2 and 118.8, 117.9 and 117.8 (each C-Cp and C-Cp′), 69.4 (C-6), 66.8 [1-O*C*H$_2$(C$_6$H$_5$)], 60.6 (C-3), 58.4 (C-9), 53.3 (10-O*C*H$_3$), 31.4 [3-*C*H(CH$_3$)$_2$], 31.2 [6-*C*H(CH$_3$)$_2$], 29.1 [9-*C*H(CH$_3$)$_2$], 21.4−17.2 [3-CH(*C*H$_3$)(*C*H′$_3$), 6-CH(*C*H$_3$)(*C*H′$_3$), 9-CH(*C*H$_3$)(*C*H′$_3$)] ppm.

Boc-12(pept) (Boc-Val-Val-Val-OMe):[40] Reaction of Boc-Val-Val-OH (1.00 g, 3.16 mmol) with HCl·H-Val-OMe (530 mg, 3.16 mmol), triethylamine (0.44 mL, 3.16 mmol), and IIDQ (959 mg, 3.16 mmol) yielded 3.16 g (71%) of Boc-**12**(pept). R_f = 0.36 (ethyl acetate/cyclohexane, 2:1). M.p. (DSC): 157 °C. [α]$_D$ = −36 (*c* = 1.0, CH$_2$Cl$_2$). IR (KBr): ṽ = 3290 (br. s, NH), 2966 (s), 1746 (m, COO), 1691 (s, CON), 1643 (vs, CON), 1550 (s), 1525 (s), 1392 (w), 1367 (w), 1299 (w), 1246 (m), 1019 (w) cm^{-1}. C$_{21}$H$_{39}$N$_3$O$_6$ (429.6): calcd. C 58.72, H 9.15, N 9.78; found C 59.21, H 9.14, N 9.68.

Reaction of Boc-12(pept) with 13

Boc-12(coord^4)/Boc-12(coord^7) = 1:3. Boc-12(coord^4): ^{1}H NMR: δ = 6.84 (br., 1 H, 8-H), 6.61 (br., 1 H, 5-H), 6.36 and 6.35 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.47 (br. d, ^3J = 8.1 Hz, 1 H, 2-H), 4.55 (dd, ^3J = 8.8, ^3J = 5.0 Hz, 1 H, 6-H), 4.44 (dd, ^3J = 8.8, ^3J = 6.9 Hz, 1 H, 9-H), 4.03 (dd, ^3J = 8.1, ^3J = 4.8 Hz, 1 H, 3-H), 3.74 (s, 3 H, 10-OC*H*$_3$), 2.21 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 2.12 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 2.09 [m, 1 H, 9-C*H*(CH$_3$)$_2$], 1.38 [s, 9 H, 1-OC(C*H*$_3$)$_3$], 1.30 (s, 3 H, Ti−C*H*$_3$), 0.99 and 0.97 [2 × d, 2 × ^3J = 7.1 Hz, 2 × 3 H, 9-CH(C*H*$_3$C*H*′$_3$)], 0.95 and 0.87 [2 × d, 2 × ^3J = 7.2 Hz, 2 × 3 H, 3-CH(C*H*$_3$C*H*′$_3$)], 0.92 and 0.90 [2 × d, 2 × ^3J = 7.2 Hz, 2 × 3 H, 6-CH(C*H*$_3$C*H*′$_3$)] ppm. ^{13}C NMR: δ = 170.6 (C-10), 169.1 (C-7), 160.5 (C-1), 117.2 and 117.0 (C-Cp and C-Cp′), 89.1 [1-O*C*(CH$_3$)$_3$], 60.7 (C-3), 59.0 (C-9), 57.3 (C-6), 53.4 (10-O*C*H$_3$), 52.5 (Ti−*C*H$_3$), 32.1 [3-*C*H(CH$_3$)$_2$], 31.9 [9-*C*H(CH$_3$)$_2$], 31.2 [6-*C*H(CH$_3$)$_2$], 28.2 [1-OC(*C*H$_3$)$_3$], 19.7−16.2 [3-CH(*C*H$_3$C*H*′$_3$), 6-CH(*C*H$_3$C*H*′$_3$) and 9-CH(*C*H$_3$C*H*′$_3$)] ppm (C4 signal not observed). **Boc-12(coord^7):** ^{1}H NMR: δ = 9.09 (br. d, ^3J = 9.2 Hz, 1 H, 8-H), 6.54 (br. d, ^3J = 5.5 Hz, 1 H, 5-H), 6.31 and 6.29 (2 × s, 2 × 5 H, Cp-H and Cp′-H), 5.13 (br., 1 H, 2-H), 2 × 3.86 (m, 1 H, 3-H and 6-H), 3.83 (s, 3 H, 10-OC*H*$_3$), 3.64 (dd, ^3J = 9.2, ^3J = 7.7 Hz, 1 H, 9-H), 2.33 [m, 1 H, 3-C*H*(CH$_3$)$_2$ or 6-C*H*(CH$_3$)$_2$], 2.26 [m, 1 H, 9-C*H*(CH$_3$)$_2$], 1.93 [m, 1 H, 3-C*H*(CH$_3$)$_2$ or 6-C*H*(CH$_3$)$_2$], 1.47 [s, 9 H, 1-OC(C*H*$_3$)$_3$], 1.22 [s, 3 H, Ti−C*H*$_3$), 1.07 and 0.97 [2 × d, 2 × ^3J = 7.1 Hz, 2 × 3 H, 3-CH(C*H*$_3$C*H*′$_3$) or 6-CH(C*H*$_3$C*H*′$_3$)], 1.01 and 0.88 [2 × d, 2 × ^3J = 7.2 Hz, 2 × 3 H, 3-CH(C*H*$_3$C*H*′$_3$) or 6-CH(C*H*$_3$C*H*′$_3$)], 0.99 and 0.98 [2 × d, 2 × ^3J = 7.1 Hz, 2 × 3 H, 9-CH(C*H*$_3$C*H*′$_3$)] ppm. ^{13}C NMR: δ = 181.7 (C-7), 171.8 (C-4), 168.9 (C-10), 157.9 (C-1), 116.9 and 116.8 (C-Cp and C-Cp′), 82.2 [1-O*C*(CH$_3$)$_3$], 61.7 (C-3 or C-6), 60.5 (C-9), 59.1 (C-3 or C-6), 53.2 (10-O*C*H$_3$), 51.7 (Ti−*C*H$_3$), 30.3 [9-*C*H(CH$_3$)$_2$], 29.5 [3-*C*H(CH$_3$)$_2$ or 6-*C*H(CH$_3$)$_2$], 28.3 [3-*C*H(CH$_3$)$_2$ or 6-*C*H(CH$_3$)$_2$], 28.1 [1-OC(*C*H$_3$)$_3$], 19.7, 19.2, 19.1, 19.0, 17.3 and 16.2 [3-CH(*C*H$_3$C*H*′$_3$), 6-CH(*C*H$_3$C*H*′$_3$) and 9-CH(*C*H$_3$C*H*′$_3$)] ppm.

Products Boc-12(chel^A)/Boc-12(chel^B) = 2:3: Reaction of Boc-**12**(pept) (176 mg, 4.10·10^{-4} mol) with **13** (239 mg, 4.10·10^{-4} mol) yielded 364 mg (96%) of the isomeric mixture Boc-**12**(chel^A)/Boc-**12**(chel^B) = 2:3. M.p. (DSC): 59 °C (dec.). [α]$_D$ = −19 (*c* = 0.80, CH$_2$Cl$_2$). IR (KBr): ṽ = 3334 (br., NH), 3057 (w), 2966 (s), 1743 (m, COO), 1653 (vs, CON), 1507 (s), 1481 (s), 1456 (s), 1371 (w), 1260 (m), 1155 (s), 1017 (m), 816 (s), 734 (m), 705 (vs) cm^{-1}. C$_{55}$H$_{68}$BN$_3$O$_6$Ti (925.9): calcd. C 71.35, H 7.40, N 4.54; found C 70.45, H 7.64, N 4.52. **Boc-12(chel^A):** ^{1}H NMR: δ = 7.66 (br. d, ^3J = 8.5 Hz, 1 H, 5-H), 6.29 (br. d, ^3J = 7.1 Hz, 1 H, 8-H), 6.17 and 6.06, 6.17 and 6.01 (each 2 × s, each 2 × 5 H, each Cp-H and Cp′-H), 4.54 (dd, ^3J = 7.1, ^3J = 4.7 Hz, 1 H, 9-H), 4.50 (d, ^3J = 3.0 Hz, 1 H, 3-H), 4.21 (dd, ^3J = 8.5, ^3J = 6.5 Hz, 1 H, 6-H), 3.75 (s, 3 H, 10-OC*H*$_3$), 2.30 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 2.22 [m, 1 H, 9-C*H*(CH$_3$)$_2$], 2.13 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 1.53 [s, 9 H, 1-OC(C*H*$_3$)$_3$], 1.13 and 1.04 [2 × d, 2 × ^3J = 7.1 Hz, 2 × 3 H, 3-CH(C*H*$_3$)(C*H*′$_3$)], 1.03 and 1.02 [2 × d, 2 × ^3J = 7.4 Hz, 2 × 3 H, 6-CH(C*H*$_3$)(C*H*′$_3$)], 0.94 and 0.92 [2 × d, 2 × ^3J = 7.5 Hz, 2 × 3 H, 9-CH(C*H*$_3$)(C*H*′$_3$)] ppm. ^{13}C NMR: δ = 178.2 (C-4), 171.9 (C-10), 168.9 (C-7), 154.2 (C-1), 119.0 and 118.7, 117.9 and 117.6 (each C-Cp and C-Cp′), 84.9 [1-O*C*(CH$_3$)$_3$], 69.3 (C-3), 60.2 (C-6), 57.6 (C-9), 52.7 (10-O*C*H$_3$), 34.7 [3-*C*H(CH$_3$)$_2$], 31.2 [9-*C*H(CH$_3$)$_2$], 30.7 [6-*C*H(CH$_3$)$_2$], 28.7 [1-OC(*C*H$_3$)$_3$], 20.3−16.9 [3-CH(*C*H$_3$)(*C*H′$_3$), 6-CH(*C*H$_3$)(*C*H′$_3$), 9-CH(*C*H$_3$)(*C*H′$_3$)] ppm. **Boc-12(chel^B):** ^{1}H NMR: δ = 6.90 (br. d, ^3J = 8.2 Hz, 1 H, 8-H), 6.17 and 6.06, 6.17 and 6.01 (each 2 × s, each 2 × 5 H, Cp-H and Cp′-H both isomers), 5.18 (d, ^3J = 3.4 Hz, 1 H, 6-H), 5.09 (br. d, ^3J = 7.3 Hz, 1 H, 2-H), 4.42 (dd, ^3J = 8.2, ^3J = 4.7 Hz, 1 H, 9-H), 3.82 (s, 3 H, 10-OC*H*$_3$), 3.61 (dd, ^3J = 9.5, ^3J = 7.3 Hz, 1 H, 3-H), 2.34 [m, 1 H, 6-C*H*(CH$_3$)$_2$], 2.29 [m, 1 H, 9-C*H*(CH$_3$)$_2$], 1.95 [m, 1 H, 3-C*H*(CH$_3$)$_2$], 1.41 [s, 9 H, 1-OC(C*H*$_3$)$_3$], 1.41 and 1.18 [2 × d, 2 × ^3J = 7.6 Hz, 2 × 3 H, 6-CH(C*H*$_3$)(C*H*′$_3$)], 1.04 and 1.02 [2 × d, 2 × ^3J = 7.4 Hz, 2 × 3 H, 9-CH(C*H*$_3$)(C*H*′$_3$)], 1.06 and 1.00 [2 × d, 2 × ^3J = 7.3 Hz, 2 × 3 H, 3-CH(C*H*$_3$)(C*H*′$_3$)] ppm. ^{13}C NMR: δ = 177.6 (C-7), 175.8 (C-4), 172.4 (C-10), 155.9 (C-1), 119.0 and 118.7, 117.9 and 117.6 (each C-Cp and C-Cp′), 80.9 [1-O*C*(CH$_3$)$_3$], 69.4 (C-6), 59.5 (C-9), 58.0 (C-3), 53.3 (10-O*C*H$_3$), 35.9 [6-*C*H(CH$_3$)$_2$], 31.6 [9-*C*H(CH$_3$)$_2$], 29.1 [3-*C*H(CH$_3$)$_2$], 28.2 [1-OC(*C*H$_3$)$_3$], 20.3−16.9 [3-CH(*C*H$_3$)(*C*H′$_3$), 6-CH(*C*H$_3$)(*C*H′$_3$), 9-CH(*C*H$_3$)(*C*H′$_3$)] ppm.

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